# OR
## YEARBOOK

from
## HOSPITAL TOPICS

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# O.R. YEARBOOK

from

# HOSPITAL TOPICS

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# Foreword

This is the twelfth volume of the O.R. Yearbook from HOSPITAL TOPICS. Like the previous Yearbooks, it brings together in a permanent reference form the important material published in the O.R. Section of the magazine during the year. Again this year, as a service to our readers, we have included selected material from other sections of the magazine because we thought it was of particular interest to the operating-room staff.

Editorial material presented in the O.R. Section is selected and prepared by the HOSPITAL TOPICS staff. The guidance of Carl W. Walter, M.D., of the surgical staff of Peter Bent Brigham Hospital, Boston, and of Dorothy W. Errera, R.N., is gratefully acknowledged.

Gordon M. Marshall

**Publisher**

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Numbers in parenthesis indicate month in which article originally appeared.

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# Symposium on the O.R. Nurse

WITH the increasing use of technicians in the operating room, there is increasing concern among operating-room nurses about the invasion of their domain and its possible effect on the quality of patient care. Many argue that a technician, trained principally in the mechanical aspects of the job of the scrub nurse, cannot provide as intelligent assistance to the surgeon as the registered professional nurse, with her far greater knowledge of anatomy and all the factors involved in patient care.

Furthermore, many O.R. nurses express disagreement with the statement of the Joint Commission on Accreditation of Hospitals that it is permissible to use technicians as scrub nurses, but that only registered nurses should serve as circulating nurses.

In the first article in this symposium on operating-room nursing, HOSPITAL TOPICS has asked the director of the Joint Commission, Kenneth B. Babcock, M.D., to explain the commission's reasons for its opinion. In the second article, O.R. supervisors analyze qualifications needed by the scrub nurse and circulating nurse, and discuss use of technicians.—THE EDITORS.

## I. The Key Role of the Circulating Nurse

***An interview with Kenneth B. Babcock, M.D.***

**Q. Dr. Babcock, operating-room nurses are very much interested in the Joint Commission's opinion of the relative qualifications needed for the job of scrub nurse and of circulating nurse. You have made the comment—in a talk before the national AORN congress last year—that the job of circulating nurse requires the exercise of more professional judgment than that of the scrub nurse. You have also said that some hospitals are using technicians as circulating nurses—and that a hospital engaging**

**in this practice is not safe. Would you expand on these statements?**

A. Prior to World War II, it was more or less a requirement of the American College of Surgeons that only registered nurses function as scrub nurses and as circulating nurses in the operating room. With the advent of the war and the shortage of nurses, hospitals, as a matter of expediency, began to use practical nurses or trained nurse aides in the operating room. Immediately questions were asked concerning the ethics, the legality, and many other aspects of the use of nonprofessional personnel.

Following the war, the College of Surgeons, and later the Joint Commission on Accreditation of Hospitals, revised their opinion of the necessity for only R.N. coverage in the operating room, and stated that they believe that the job of a scrub nurse is that of a technician. It is a mechanical job which can be done by someone of less training and intelligence than a registered nurse—if the person is taught properly.

With this concept, we have allowed hospitals to use trained technicians in the operating room, whether they be nurse aides, medical students, or practical nurses. When we say that the job of scrub nurse is a technical job which does not require judgment, we mean that the scrub nurse does not have to make decisions affecting patient care.

The opinion of the American College of Surgeons and of the commissioners of the Joint Commission concerning the circulating nurse is that she will directly supervise the scrub nurse and that, if there are decisions to be made, she is in the position to make them. Therefore, she must be a registered nurse, and it is her decision as to whether technic is faulty, or whether a change should be made in the course of the nursing care of the patient. She is in charge of that operating room as far as nursing care is concerned—of course, subservient to the surgeon on the case.

The attorneys general in several states have stated that in their opinion it is perfectly proper, if it is common usage in hospitals, and the hospitals can prove that the individual acting as scrub nurse has had adequate training, to utilize a technician as a scrub nurse.

I'm not a lawyer—and each state should consult with its own attorney general—but the laws in the different states stipulate that only a registered nurse may utilize judgment as far as nursing is concerned. In other words, a practical nurse or a nurse aide is not allowed the privilege of utilizing judgment in the treatment or care of patients, and she always must be under the direct supervision of a registered nurse. It is for these reasons as enumerated that the commissioners of the Joint Commission took their stand that a practical nurse or nurse aide may

serve as a scrub nurse, but a registered nurse must serve as circulating nurse.

**Q. Some supervisors have made the point that the circulating nurse often has to be in and out of the room quite a bit—perhaps on errands for the anesthesiologist or other members of the team. Suppose, then, that she is out of the room when a situation arises that might require the use of judgment—would the scrub nurse be qualified?**

**One supervisor told us that the registered nurse can make substitutions and think faster than a nonprofessional. She also made the point that scrub nurses have helped to teach the residents good technic, and that doctors may take criticism from an experienced scrub nurse who is an R.N., whereas they wouldn't accept it from a technician; and that also the technician might not dare to correct a break in technic by the doctor, whereas the R.N. scrub nurse wouldn't feel so reluctant to do so.**

A. I don't agree entirely with what you have just said. It would be my feeling that if the circulating nurse were out of the room at the time judgment was required, there would be two avenues of approach left for the scrub nurse: one, to ask the doctor—who is there and who must be there—what to do, or, two, to wait the few seconds or minutes until the circulating nurse comes back.

The need for a split-second decision by a scrub nurse does not arise in one out of 1,000 cases.

With regard to breaks in technic, I believe that if a scrub technician observes a break in technic, even though she considers herself a lowly technician, she is duty- and honor-bound to live up to her responsibilities and report it. She cannot refuse to notify the surgeon or whoever is in charge, just because she feels there might be criticism. The patient's protection comes first, not the status or the feelings of the individual.

**Q. Would it then depend possibly on how she was instructed as to whether she would be conscientious enough—**

A. There is no question in the utilization of nurse aides or practical nurses. They must of course be responsible individuals with enough integrity to know what is right and what is wrong and to say so if the time comes.

**Q. I would like to call your attention to the job descriptions for the scrub nurse and the circulating nurse which appear in the book, "Job Descriptions and Organizational Analysis for Hospitals and Related Health Services," published in 1952. Would you say that these are somewhat outdated?**

A. Yes. For instance, as a part of the description of the work performed by the scrub nurse, there is the statement, "Observes patient during surgical pro-

cedures for complications, such as hemorrhage, and furnishes emergency equipment and supplies to prevent fatality." I question very much the ability of a scrub nurse to observe a patient and know whether complications are coming unless they are so gross that the surgeon and circulating nurse have seen them long before.

**Q. Dr. Babcock, why do you think the job of scrub nurse has such a great appeal for the R.N.? Some nurses say that they went into operating-room nursing because they wanted to scrub, and that when you take this duty away from them, you're taking away one of the things they enjoy the most.**

A. We have heard the same statement—that many love to scrub, and they are very unhappy if they're not allowed to do it. There is a certain glamor to being the operating nurse, or operating scrub nurse. The status of this job is recognized in many hospitals that utilize nurse aides, by giving the aide in the operating room a little higher salary than the average aide on the floors, because she has taken extra special training and deserves more pay.

Movies and other media have more or less dramatized the operating room with all its supposed crises and all the rest, and I know of no other reason that many nurses like and want operating-room work, but that's up to them.

**Q. Do you think there is anything to the idea that the nurse who has this great love for scrubbing perhaps wanted to be a surgeon and that standing there next to him, sharing with him, is the next best thing? A nurse once told us quite frankly that the reason she enjoyed scrubbing for neurosurgery was that it was the next best thing to being a neurosurgeon herself.**

A. I think that idea has much basis in fact. Nurses have a very great sense of being part of the picture, of helping this patient very dramatically. They might have wanted to be surgeons; they want to share in the glamor of saving a patient's life in the operating room.

**Q. It's said that a good scrub nurse doesn't have to be told by the surgeon what instrument he needs; she has his instruments ready, and he doesn't even have to ask for them. Learning to anticipate the needs of the surgeon is part of being an intelligent scrub nurse, and of course nurses argue that the R.N. is much better qualified to do this than the technician is.**

A. I could disagree with that to the extent that I have seen several hundred, if not thousand, nurses' aides who are just as good scrub nurses as some of the very best R.N.'s. They take pride in their work, and they can anticipate the surgeon just as well as a

registered nurse, and need no prodding or calling for instruments. They can anticipate his every need. Before I came to my present position, I was a hospital administrator, and the operating-room technicians in my own hospital had that reputation.

**Q. One supervisor whom we queried about qualifications for circulating nurses listed ability to move patients as an important qualification. She said her hospital had used male nurses or male technicians as circulators, when they were available, and has found them helpful because they are able to move the patient. How important is that particular qualification?**

A. There is no question that a male might have a strong back, but an untrained male could do untold harm if he didn't know how to move a patient from the operating table to the stretcher, or vice versa. For example, someone with judgment must oversee the moving of a patient who has had a slipped disc operation or other spinal surgery, or the whole operation can be spoiled simply by moving the patient too carelessly. The same is true of many orthopedic procedures. If judgment isn't used and that patient moved carefully, arduous hours of setting a fracture can be undone in a few seconds. Somebody with judgment ought to supervise the moving of patients, which is very important.

**Q. That would be part of the job of the circulating nurse?**

A. At least, if not to do it, to supervise it, to make sure that it's done all right.

**Q. Regardless of how nurses feel about the use of technicians, most hospitals seem to be coming around to using them, because there just aren't enough nurses to go around.**

A. Yes. Actually, we have had very little trouble over the use of technicians (as scrub nurses). Our big problem is the desire of hospitals to use them also as circulating nurses, because of the increasing shortage of nurses—the demand of several large hospitals to have one registered nurse circulating for four or five operating rooms, supervising non-registered nurses who are the local circulating nurses in those operating rooms. This situation is somewhat similar to that of a hospital which is covered at night by only one floating night supervisor, under whom are only practical nurses and nurses' aides.

In something as critical as an operation, we do not think that a circulating nurse can properly supervise four or five operating rooms at one time. We demand that there be at least one registered nurse in every major operating room in the capacity of a circulating nurse. Please note, I use the word "major"; I don't think that it's necessary in the lancing of a boil . . .

but at least on a major case, when there is opening of a body cavity, or the patient is critical.

**Q. Do you think we will ever have some kind of standardized program for the training of surgical technicians? There doesn't seem to be any. Every hospital has its own program. The lengths of the program vary; the material taught seems to vary.**
A. Your statement is true, and I hope that ultimately there may be a standardization. As long as the training of nurse aides and practical nurses in O.R. technic is given in a particular hospital, you are going to get as many different kinds of training as there are hospitals that offer the training. Until operating-room technicians are given such status that there are state or national schools for them, you're going to get as many different kinds of training as there are trainees. This cannot be helped. If you give these people more status and send them away to schools instead of training them locally, the training then becomes expensive, and hardly warranted because technicians are not a stable group of employees. I do not have any anticipation at the present time of state or national schools for technicians in the operating room.

**Q. What about the possibility of a standardized manual for the student, such as the one for the instructor, published by the American Hospital Association?**

A. There is no student manual that I know of, per se, except those written up by individual hospitals.

**Q. Dr. Babcock, some operating-room nurses report that when they have both professional student nurses and technicians in the operating room, there is a status problem. The students look down on the technicians, and the technicians resent being ordered around by the students. Is there any way of getting around that?**

A. A wise supervisor of the operating room will confine her student nurses to being under the supervision of registered nurses. If there are eight operating rooms, let us say, she will confine them to four, and the other four could then be staffed by technicians under the supervision of registered nurses. There would be no crossing of the paths. A student is in a learning capacity, and should always be under the supervision of a registered nurse, just as the nurse aide is.

Status problems are not confined to students and aides. Nurses who are graduates of collegiate schools may look down upon graduates of hospital schools, and the graduates of hospital schools may look down on the practical nurses and the aides. But, if they do, we think they are being rather small. We're all out for the improvement of medical care and good patient care, which is not a question of trying to feel superior to somebody else.

# II. Supervisors Speak: On Qualifications For O.R. Nurses, Use of Technicians

What do O.R. supervisors consider when they are assigning personnel on cases? Which job requires more talents and involves more responsibility—that of the scrub nurse or the circulating nurse?

HOSPITAL TOPICS asked a dozen supervisors in different parts of the country to answer these questions:

**1. Which position, in your opinion, requires the exercise of the most judgment—the job of the scrub nurse, or the circulating nurse? Why?**

**2. When you are assigning personnel for surgery, what points do you consider in deciding who is to scrub and who is to circulate? If you had two persons available, and one you considered definitely superior in all-around experience and intelligence, to which position would you assign her?**

**3. Would you list what you consider to be the requirements for a good scrub nurse and for a good circulating nurse?**

**4. Are you now using technicians in your operating room and, if so, in what position?**

Eight of the 12 replied in detail—and seven out of eight said that they would assign the better qualified person as the circulating nurse. Commented Mrs. Ethel I. West, national AORN president: "The circulating nurse has a wide area of responsibility. She must assume the total responsibility of the individual operating room. In addition to anticipating the needs of the surgical team, including the anesthetist, she serves the patient in a more general aspect. Often the family needs must be recognized, as she may be the only contact for the patient. She may also have the responsibility for seeing that everything is in readiness for the next case or cases in her room."

And Bessie L. Bowen, VA Hospital, Jackson, Miss., though emphasizing the need for well-trained, skilled personnel in both positions, declared: "In my opinion, the duties of the circulating nurse require the exercise of more professional judgment, especially as emergencies arise. The circulating nurse observes the entire situation in an operating room and must provide services to each member of the surgical team and at the same time maintain an aseptic and safe atmosphere for the patient.

"With the devices, gadgets, complicated procedures, and methods used in the complex surgery of today, the circulating nurse must be well trained, informed, and skilled in modern surgical thought so that she is able to recognize changes in the condition of the patient, and anticipate the numerous needs of the surgeon, the anesthesiologist, and the scrub nurse, and she must exercise sound judgment in providing these needs in the order of their importance.

"The duties of the circulating nurse are comparable to those of a head nurse on a patient-care unit, as she must see that everything possible is done for the care of the patient during the time he is in the operating room, subject, of course, to the over-all authority of the surgeon. A well-trained technician could possibly carry out the duties of a scrub nurse effectively in most instances."

Sister M. Jerome Emilian, St. Mary Desert Valley Hospital, Apple Valley, Calif., pointed out the difficulty in making a definitive statement as to which position requires the exercise of the most judgment, saying, "Each of these areas has its own unique responsibilities and situations which require prompt, accurate and important judgments. Routine cases, if there are such things, still contain the possibilities of those exceptional and highly stressful ones. . . . Certainly the position of the circulating nurse entails a very wide and comprehensive range of activities and possible judgments and decisions.

"However, the scrub nurse with a good understanding of her role in the total care of the patient and with those influential factors, her skills and judgments during the actual performance of the surgical procedure, has a position which naturally requires much more than mechanical skills and conditioned reflexes.

"Generally speaking, I would assign the individual with what I considered superior experience and intelligence to the position of circulating nurse. However, if the nature of the needs of an individual case (seemed to require it), I would not hesitate to place this person in the position of the scrub assistant."

Sister Catherine de Sienne, of Montreal, in agreeing with the others that the job of the circulating nurse required the exercise of more judgment, pointed out that the circulating nurse's responsibilities extend to the patient, the surgeon, the anesthetist, and the hospital authorities—the administrator, the director of nursing, and the operating-room supervisor. She gave several specific duties as examples:

"A. *Identification.* At our hospital a patient undergoes four different procedures of identification before entering the operating room. The circulating nurse reviews: the call slip; the arm identification band and bed plate; laboratory tests, and legal con-

sent for operation. She then gives her report to the surgeon and the anesthetist who together, once the patient is placed on the operating table, give him his fifth and last identification.

"That new intern is determined to finish his rounds on time."

"B. *Positioning.* Safe and correct positioning is essential. Not all surgeons have the privilege of always having the same assistants during a period of six months or more. The assistant may be very good in neuro, but may not have had the opportunity of assisting in infantile surgery. Then on whom does the surgeon depend to protect his patient from a brachial paralysis on his radical mastectomy case, or to put the 4" x 10" cushion under the right region of the pyloric stenosis of the one-month-old baby? The circulating nurse. Although the surgeon is alone responsible for his case, on whom may he depend to place correctly the indifferent electrode pad used with the cautery machine? The circulating nurse.

"C. *Aseptic technic.* The circulating nurse in full view of the activities of the theatre protects the patient from possible slips in technics, by members of the team, and also from outsiders such as visitors, students, the pathologist, and x-ray technicians.

"D. *Sponge count.* Although it is the surgeon's responsibility to remove all sponges from the abdomen or the spinal column, the circulating nurse has the responsibility of giving the correct result of the final count.

"E. *Dressing.* The dressing on aseptic cases presents no complications to the assistants, generally speaking. Such is not the case with septic dressings, where contamination may spread rapidly. The circulating nurse must be depended upon to apply the

principles of aseptic technic at all times. She is required by the team to furnish the necessary supplies to carry out the aseptic technic in a scheduled septic case and also as soon as a septic condition is ascertained."

Moreover, Sister Catherine declared, it is to the circulating nurse to whom the team turns in emergencies such as cardiac arrest or uncontrollable hemorrhage. Is cases of cardiac arrest, she knows where the equipment is located; she starts the chronometer and brings the cardiac-arrest cart and drugs; and it is she whom the surgeon calls upon to operate and control the defibrillator at the right volume.

When uncontrollable hemorrhage occurs, the anesthetist, surgeon, and scrub nurse turn to the circulating nurse for extra blood, for help in installing all IV paths available, for keeping the patient warm, and for extra hemostats and "those special curved and longer forceps the surgeon has seen somewhere in some instrument room, and which are indispensable to him in this case."

Vivian Warren, White Memorial Hospital, Los Angeles, believes that in more difficult cases the circulating nurse and the scrub nurse should have the same qualifications. She explained that the nurses who have been in her department the longest do the circulating, because they know the department and the doctors much better and are able to assist the scrub nurses.

"We rotate our nurses to give them experience in circulating and scrubbing," she said. "New nurses coming to the department scrub first after orientation . . . always with older personnel. Experienced nurses are always used for heart, vascular, and neurosurgery."

The importance of a calm, experienced circulating nurse to a smooth-running operating room was emphasized by Sister Alexine, Mercy Hospital, San Diego. Among the points she made were:

"The circulating nurse has the responsibility for a well-ordered plan of action. The immediate care of the surgical patient admitted to the O.R. suite is important. A quick, intelligent survey of the patient's chart, noting identification, diagnosis, permit, history and physical examination, consultations, laboratory and x-ray reports, religion, and so forth, is imperative.

"As many patients are aware of their surroundings, a calm, concerned reassurance of the circulating nurse is of great assistance to the patient.

"The progress of the operation often depends on the tools and materials provided by the nursing members of the O.R. team. An alert, interested circulating nurse will know what is needed and see that it is where it is needed, before the operation is brought to a halt while a three-yard dash is being executed to provide the missing items.

"If the scrubbed members of the O.R. team be-

come excited, weary and impatient, a calm, experienced circulating nurse is the answer to an O.R. supervisor's prayer."

"Unquestionably the circulating nurse is called upon to exercise more judgment in any operation," declared Linda K. Alden, Monmouth Medical Center, Long Branch, N. J. "She is the 'case organizer'; she arranges for and participates in preparing the operating room for the patient, checks the patient and chart to see whether everything is in order, reporting deviations as they occur."

She also mentioned the circulating nurse's role in reassuring the patient, assisting the scrub nurse and anesthetist, observing the operation and anticipating the need of additional supplies or equipment, preparing for transfer of the patient out of the operating room, and then making the necessary preparation for the following case.

Betty M. Egan, VA Hospital, Boston, did not agree with the others in the group. She would assign the better-qualified person as the scrub nurse and the other as the circulating nurse.

"In all instances, I have found plenty of people free to help the circulator, such as extra doctors, the supervisor, or her assistant," she commented.

"I do not feel that it is just a matter of judgment. It is anticipating the needs of the surgeon, having good knowledge of what he is trying to do, and having the equipment ready that he is going to need without his asking for it.

"A circulator is in and out of the room quite constantly for the team and in particular for the anesthetist. If there is a registered nurse scrubbed, she can make substitutions and think faster than a nonprofessional, who is apt to panic in time of an emergency.

"We also know that for years it has been the scrub nurses who have taught young residents good technic, and you can do this only when you are scrubbed with them and helping them. Doctors will take constructive criticism from an experienced nurse that they will not take from a technician. I feel also that technicians would not correct a doctor on breaks in technics because of their status.

"If the registered nurse is the circulator, she will not be in the room all of the time to see things going on because of the nature of her duties. I feel that every operation is a major one to the patient, and we owe him the best protection and care we can give him while he is in the operating room.

"To be sure, there are procedures where technicians can scrub, such as hemorrhoids, pilonidal sinuses, and biopsies; however, I feel that a good scrub nurse is an asset to the patient and the surgeon and also aids in the speed of the procedure, which is very important because of (the possibility of) staphylococcal infections."

Miss Egan, who has had both male and female circulating nurses, prefers the male because men are better able to lift and position patients.

"This job is a very important one and usually is left to the circulator, whether professional or nonprofessional. In this, they are far better than doctors because they do it constantly. For scrubbing, however, I feel that men with no professional background are clumsy with their hands in comparison with females."

When nonprofessional personnel are used as circulators, however, Miss Egan emphasized that one or two graduate nurses must be free to help and supervise them at all times.

What factors are taken into consideration in assigning personnel for surgery? The supervisors agreed generally in their answers. Some of the specific factors mentioned were:

—Type of surgery to be performed. Certain teams are better suited for specialized surgery such as heart cases, neurosurgery, orthopedics, and plastic surgery.

—The condition of the patient and extent of anticipated surgery.

—Surgeon's preference (for personnel whom he likes and believes competent).

—Nurse's preference for a particular type of surgery.

***Our thanks for their comments go to . . .***

*Mrs. Ethel I. West, R.N.*, operating-room supervisor, Methodist Hospital of Southern California, Arcadia, and president, Association of Operating Room Nurses.

*Bessie L. Bowen, R.N.*, operating-room supervisor, VA Hospital, Jackson, Miss.

*Sister M. Jerome Emilian, R.N.*, operating-room supervisor, St. Mary Desert Hospital, Apple Valley, Calif.

*Sister Catherine de Sienne, R. N.*, operating-room supervisor, L'Hôpital Sainte-Justine, Montreal, Que., Canada.

*Vivian Warren, R.N.*, operating-room supervisor, White Memorial Hospital and Clinic, Los Angeles.

*Betty M. Egan, R.N.*, operating-room supervisor, Monmouth Medical Center, Long Branch, N.J.

*Sister M. Alexine, R.N.*, operating-room supervisor, Mercy Hospital, San Diego, Calif., and member, board of directors, Association of Operating Room Nurses.

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—Consideration for surgeons and nurses who "grate" on one another (personality problems).

—Ability, experience, and adaptability of the nurse.

"There can be no set rules governing the selection of persons to function in a particular role in the operating room," Mrs. West pointed out. "Good supervision requires a knowledge of capabilities of personnel. Assignment is made accordingly."

The type of surgery was mentioned by all as an extremely important factor in their decision as to who should scrub and who should circulate. If a patient's condition were critical, Mrs. West said, and it became apparent that a slow scrub nurse would be detrimental because she would delay the case, the more experienced person might be assigned as scrub nurse, assuming that assistance would be available to support the circulating nurse. In an emergency cesarean section, for example, she said, a fast scrub nurse might assist in saving the lives of both mother and infant.

### *Requirements for Two Positions*

**Scrub Nurse:** Bessie L. Bowen, in her list of qualifications for a good scrub nurse, included almost all of those mentioned by the group:

"a. Technically competent (orderly, economical, systematic, knows the principles underlying technics, performs procedures effectively).

"b. Dependable (trustworthy, thorough, conscientious, accurate, and punctual).

"c. Cooperative (intelligently loyal, fair-minded, a good 'team worker,' understands personal relationships and is able to adapt to various types of personalities).

"d. Mentally alert (intelligent, observant to anticipate needs of surgeon, physical and mental stamina, manual dexterity to manipulate instruments and equipment, memory for details).

"e. Healthy—mentally and physically (emotionally mature under normal and emergency situations, able to work rapidly and with accuracy for long periods of time).

"f. Personally responsible (recognizes her special responsibilities as a member of a team and a profession; is keenly interested in and actively concerned in the welfare of the patient; works with the realization that errors and incompetence may have serious consequences for the patient; keeps herself informed by reading professional journals, attending and participating in inservice programs)."

**Circulating Nurse:** She should have the same requirements as the scrub nurse, plus, the supervisors noted, an ability to inspire confidence in the patient and in the surgeon; to organize, teach, supervise, evaluate, and direct; to remain calm in emergencies, and to observe the patient carefully and anticipate the needs of the surgical team.

### *Use of Technicians*

All of the eight who replied said that they are now using technicians in some capacity in the operating

room. Miss Egan is using them as circulators; Miss Bowen is using nursing assistants to circulate and assist with minor surgical procedures "according to VA regulations."

Sister Jerome Emilian's staff consists of one registered nurse and one technician. The supervisor says: "The interest and self-direction shown by the technician in our team is remarkable, and she has made good use of her opportunities to learn and develop in her particular area of endeavor. For the most part, she is used as the scrub assistant, but on certain occasions she does circulate under the direction of the supervisor or assists the registered nurse who is actually circulating.

"If the day's schedule is such that fatigue is a highly influential factor, it might be that the registered nurse and surgical technician would alternate positions several times, the supervisor then assisting the technician as she circulates for the surgical team. The two staff members function harmoniously, each recognizing the other's areas of responsibility and professional levels."

The Methodist Hospital of Southern California has one technician in the operating room. After three and one-half years of service, she is able to function in practically any area of the department, according to Mrs. West. Her duties consist of assisting in the cystoscopic room, scrubbing for minor cases, and circulating on most major cases. She is always under the supervision of an R.N.

"The surgical technician requires more supervision than the average professional nurse," Mrs. West warned. "Technicians are often more enthusiastic in their desire to serve in the operating room, but let us be understanding and cognizant of their limitations. We realize the necessity in many operating-room departments of employing technicians as a supplement to the professional staff, but there are few instances in which they substitute for skills acquired through the education and background of the professional nurse program."

Their duties should be carefully defined, she emphasized, and consideration given to experience, preparation, and personal aptitude.

At L'Hôpital Sainte-Justine, Sister Catherine is using technicians who have experience but no formal training—in ENT, where they scrub exclusively for tonsillectomies; in the cast rooms; and in the septic-technic area, in which are performed such cases as abscesses, rectal and sigmoid examination, infected dressings, and infected ingrowing toenail—but no major surgery.

Mercy Hospital, San Diego, has three male, Navy-trained O.R. technicians and one female technician. "Ninety-nine percent of the time they scrub on the team and are very satisfactory," Sister Alexine reported.

Though technicians are often considered an unstable employee group, the one technician on the O.R. staff at White Memorial Hospital has been there 10 years. He has circulated and scrubbed under supervision of an R.N. In the past, technicians at that hospital have all been scrub nurses, according to the supervisor, Vivian Warren.

At the Monmouth Medical Center, technicians have been used in the operating room for the past six years or more, according to Linda K. Alden. All have been trained on the job in the hospital.

"Some have been instructed in formal, planned classes over a two-month period," Mrs. Alden said. "The first month was a combination of theory with some practice; the second month's training consisted of closely supervised practice with a few formal classes.

"Most of the technicians we have used, however, were not so trained, but have received individual instruction with emphasis on procedures. It appears that the way training is done, provided it is thoroughly done, is not as important as the selection of the personnel. Undoubtedly the individual who was instructed in theory was more informed, knew more anatomy, etc., but those without this type of instruction perform their assignments well whether they are scrubbed or circulating.

"In any case, the technician works under the direct supervision of a registered professional nurse.

"We have also been using attendants, whose training is considerably less than that of the technicians, to circulate for selected cases, although they never scrub, and work under the direct guidance of the scrub nurse.

"We *never* assign two nonprofessionals to an operation, no matter how 'minor.'

"Just because technicians do well in their assignments does not mean that registered professional nurses are no longer necessary in the operating room. I believe that they are more than ever necessary. Because they have been educated to understand total patient care and to perform accordingly, they have the basis on which to build improvements in operating-room nursing care. Operating-room nurses must be encouraged to continue their education so that they are better able to teach professional and nonprofessional personnel to give better care to the patient."

# Technician Training, Interpersonal Relations Among Topics at AORN Congress

*The following abstracts are taken from TOPICS' report on the eighth national congress of the Association of Operating Room Nurses.*

## College-Hospital Program Trains Surgical Technicians

### *Origin*

The surgical technicians trained in our program at Sacramento City College and the Sutter General Hospital in Sacramento are recruited from our LVN program.

Before we began our program in November of 1955, we sent a questionnaire to hospitals which already had surgical technician training plans. Most of the enrollees of these plans were without previous hospital training, and there was a dropout rate of 50 to 80 percent.

There was a terrific interest in our proposed program, which was to select its members from the graduates of the LVN program. There was particular interest when we emphasized that the surgical technician was not meant to replace the nurse, or to save money, but to make skilled help available when it was needed.

Our curriculum is education-centered, rather than service-centered. This is possible because of the students' background in general hospital care. Our students are in the O.R. or in class seven hours a day,

five days a week, and a stipend of $150 per month is provided.

Since our first class in November, 1955, we have enrolled 36 surgical technicians, of whom 29 have completed the course. We conduct one six-month term per year, and although our present ratio of one teacher to six students is satisfactory, our aim is to reduce the ratio to one to four.

We have lost two of our surgical technicians—to the nursing profession. They are now enrolled in the registered nurse program.—*Lena Visintainer, R.N.*, director, Vocational Nurse Education, Sacramento City College.

### Curriculum

The curriculum of the surgical technician training program seeks to develop several objectives for the student. She should be encouraged to develop an appreciation for aseptic technic, to exercise thought in the care of the patient, to assist in skilled and unskilled duties in the O.R., to increase her general knowledge of nursing, to develop a deep sense of responsibility to the patient, and to understand that the foundation of hospital service is honesty.

The course is divided into two parts. The first is two weeks in duration, and is devoted to preclinical study and general orientation.

Ten class hours are devoted to the study of the history of surgery and its development. An appreciation of aseptic technic is fostered. Ten hours are spent on all-important ethics. The students are already accustomed to strict discipline and appreciate the importance of a well-adjusted personality. Legal aspects are explored, and watchfulness in care of patients is stressed.

Ten hours each are spent on the economics of surgery and on surgical nomenclature. Care of fine instruments is taught, and the students are acquainted with the huge capital outlay involved in the purchase of instruments and equipment. Names of basic instruments are taught, as well as names of operations, sutures, and positions, so that the technician can communicate intelligently with the O.R. staff.

Orientation to the O.R. suite occupies 25 class hours. This period acquaints the student with the physical O.R. environment. During this time four operations are observed: a tonsillectomy, a hernia, and two laparotomies. For these first experiences in the O.R., we try to observe operations done by surgeons who are sympathetic to students, and who will explain the procedure as it is being carried out. Proper scrubbing, drying, and gowning is also taught at this time.

The remaining five-and-a-half months of the course is occupied with observation in the O.R. The

student technicians wear insignia at all times.—*Rae Pittman Wood, R.N.*, instructor in vocational nursing, Sacramento City College.

### *Administration's View*

Before a surgical technician training program can be started, a genuine need for, and acceptance of, the trained surgical technician must be proved. The need is not difficult to prove; acceptance is by far the more touchy of the two.

At first, when questionnaires were sent out, surgeons and surgical nurses voiced an emphatic "no!" Since then, those same persons have become some of the most enthusiastic proponents of the program.

There are several important criteria to keep in mind when planning a surgical technician program.

1) Selection of students should be particularly careful for this specialty. Our program works well because the only persons eligible are those who have graduated from our own LVN course and have been thoroughly screened as to their probable performance in the O.R.

2) Effective coordination of the college offering the course and the affiliated hospital is essential.

3) An atmosphere conducive to learning must be maintained in the operating room, to enable the technician-student to reap the full benefits of her training.

4) A stipend should be paid.

5) The cooperating hospital should expect to employ the surgical technician graduate.

The hospital gains from a surgical technician program. Adequate surgical staffing is possible. The technicians are adequately trained and are stimulating to the professional nurse. They do not replace the surgical nurse, but are rather under the constant supervision of a registered nurse.—*Della Sunderland, R.N.*, director of nursing service, Sutter Community Hospitals, Sacramento.

### *The O.R. Supervisor's View*

Our entire O.R. staff has benefited from education that has gone into the training of the surgical technicians. They have excellent backgrounds in professional ethics, and have become a valued part of the O.R. team.

The technicians perform many types of O.R. work, often serving as second scrub or second circulating nurse. They know their limitations, and are not afraid to ask questions. Their work is performed under the direct supervision of an R.N., and they wear a cap insignia which designates them as technicians.

One registered nurse and one technician may do a sponge count; if an R.N. is not immediately available, two technicians may begin the count, provided

the count is checked and countersigned immediately by an R.N. Technicians may prepare medications under direct supervision of the nurse or doctor, but never administer them.—*Frances Burnside, R.N.*, O.R.S., Sutter Memorial Hospital, Sacramento.

## Nurse Needs Better Training in Self-Analysis

Few of us have had specific training in the dynamics of interpersonal relations. Yet, such relations are so much a part of our daily activities that by the time we become adults, we should have mastered enough to cope with any situation.

However, the nurse has many interpersonal relationships not encountered by persons in other fields. Her relationship with the patient is important; she is really his closest contact during his hospital stay. Here she is dealing with an abnormal situation, since the patient is not his real self; he is inclined to be more irritable, fearful, demanding.

Courses in psychology are mostly aimed at leading us to understand others; in our case, the patient. However, the very thing these courses have in common is perhaps their weakest point. Even courses in mental hygiene—the most personal of subjects—talk about somebody else. What the nurse really needs is not so much to understand the patient, but to understand herself.

Care of the patient during surgery is the most vital type of care. Birth is normal, death is normal, surgery is not. It is a strange environment and a frightening one. The nurse who does not understand her own reactions under such conditions is not of much psychological help to the patient.

The fact that surgical technicians are being used more in the operating room serves to make surgical nursing more a profession than ever. Along with this elevation, or rather recognition, of the professional status, goes the added burden to the nurse of truly professional interpersonal relations, of the caliber that stamps her an intelligent, capable person.

Every human mind is different from every other human mind, and so reactions to a given situation will be quite different. Though we may look somewhat alike, our behavior patterns are far from alike.

The way we speak to others is a good indication of our relationships with them, but speech is not the only criterion. The facial expression that surrounds that speech is also important. During the time I spent researching on interpersonal exchanges, I took some pictures to illustrate reactions of various persons.

Seeking to get a child's-eye view of the world, I photographed a room from a child's eye level. The fact that children remain cheerful while looking at the underside of furniture is proof of their truly buoyant spirits.

I wanted to photograph the smiling eyes of a nurse over the top of her mask. To my chagrin, I couldn't find a nurse with smiling eyes. I finally found an intern who filled the bill.

In communicating with a person who is deaf, I was interested to learn that most persons, when they have to raise their voices to make themselves heard, alter facial expressions. A simple, ordinarily friendly phrase is changed to near-belligerency when the voice is raised. This deaf person stated that most of the voices he hears and faces he views are not pleasant at all.

Nursing educators and basic nursing courses should be altered to emphasize the psychological needs of the nurse, not the patient.—*LCDR. Helen L. Brooks,* NC, U.S. Naval Hospital, San Diego, Calif.

## Nurse-Patient Interchanges Reveal Need for Understanding

Many nurses consider themselves junior psychiatrists and take on problems for which they have no training; but, on the other hand, the nurse must possess elementary skills in understanding patients. You don't have to be an expert to deal with the patient's superficial troubles.

The fact that we need to place more emphasis on interpersonal relations is evidenced by results of a survey conducted by the California Medical Association, which brought to light the following statistics:

1) Doctors were criticized by 64 percent of all patients for lacking human warmth in the doctor-patient relationship.

2) Hospital personnel were criticized by 71 percent of all patients for the care and attention—or lack of them—received in the hospital.

3) Fifty percent of all patients have changed doctors in the past year because of dissatisfaction.

4) Fifteen percent of patients fail to pay their bills. This is not always a matter of financial trouble, but is sometimes a subtle way of expressing dissatisfaction with the physician.

Medical malpractice suits, which are becoming more frequent, are another method of showing disapproval.

Since it is not always possible to schedule a social worker for the precise moment when a patient needs psychological help, nurses themselves are realizing they need basic skills in understanding. We had an idea these skills could be taught, and so ventured out on a survey of our own. Experts in psychology followed nurses throughout their day with the patients, and took down, verbatim, each verbal interchange that went on. After more than 3,000 of these interchanges had been recorded on individual cards, the cards were sorted, and we found that practically all could be categorized into five groups.

The first group we can call "evaluative." The nurse makes up her mind about the situation from the in-

formation the patient gives her. She "doesn't like the way" the patient is communicating—or not communicating—with his doctor. She tends to give advice, and this is dangerous. If she gives advice, chances are the patient won't take it—few of us do, particularly when it's for our own good. If her advice doesn't work for the patient, he has her to blame and may adopt the attitude "You told me what to do."

The second group is the hostile group. This is exemplified by the nurse who chides the patient for "certainly not acting grown-up" about his illness, and for "complaining all the time." Are we helping him at all by subjecting him to ridicule?

Denying that the patient has a particular problem is the attitude of the next group, which we may term the "reassurance" group. The nurse with syringe in hand approaches a child, and assures him that "it won't hurt a bit." He obligingly stretches out his arm, and it does hurt. That nurse may be self-satisfied on that day. The next day she may mark the child's chart "uncooperative today," after she tries to give him a hypo. What she really should state is "I fooled him yesterday, he caught on today."

The "probing" group is the next division. This one attempts to judge on further information from the patient. She probes into his personal affairs, and opens psychologic wounds.

The "understanding" response is the one we wish to preserve and teach to others. The nurse in this group responds to the patient's fearful conversation about his illness, not with jollity, reassurance, and pseudo-cheerfulness, but with a genuine "I understand you're concerned." This understanding will lead the patient to change his own attitude for a better mental state. This change cannot be effected by any amount of outside advice.

It is easier to teach this understanding attitude to a student than to a registered nurse with a master's degree. If we accept the patient's negative feelings, positive feelings will follow.—*Louis Bernstein, Ph.D.*, director of psychological services, Jewish National Home for Asthmatic Children, Denver, Colo.

# supervisory development

By Sr. Miriam Eveline*

Development means growth. It is a continuing process—sometimes hidden, sometimes slow, but always with a systematic moving forward. This growth is vital to the hospital, for without it comes stagnation and lethargy. Similarly, the individuals who comprise the hospital must themselves be in a process of development, for without this, dissatisfaction and apathy will result.

This article deals with one phase of a program in personnel research. The goal is better patient care through personnel who find job satisfaction in the hospital by increasing their potential efficiency—or in other words, by increasing the process of growth. The program was conducted by St. Vincent's Hospital, New York City, for a three-year period, 1957-60, with the aid of U.S. Public Health Service Grant W-90 for the development of scientific methods and procedures in personnel.

Before discussing our project, two distinctions should be made. First, we at St. Vincent's do not present oursevles as experts with all the answers. In applying for the research grant we hoped for financial assistance to aid us in procuring advice and help from experts. But it was our firm conviction that a sound solution for our problems could be reached only by our own staff.

Second, the research in which we have been involved is not the "pure" or basic research of the academician or scholar. University professors and students, preoccupied with the theoretical aspects of personnel management, may be drawn to problems that are more researchable rather than to those which, in practice, are most important.[1]

In a hospital where the principal services are rendered through people by means of co-ordinated teamwork in an effort to create an atmosphere of healing

*Assistant administrator, The St. Vincent's Hospital of the City of New York.

for sick human beings, improving a program of personnel administration cannot be done in an ivory tower. It requires dealing with day-to-day matters, with real phenomena; and the most real and most unpredictable is the human element itself. Such research as ours means dealing with practical, localized problems, with the hope of arriving at meaningful results which, when applied, will improve practice. Most of the problems of personnel management involve the behavior of individuals or small groups, and behavior is not changed by intellectual development alone; it requires corresponding changes at the emotional and attitudinal levels.

In a sense, the whole project has constituted a stimulating and continuing program of management development. In fact, the impact on the administrative and supervisory staffs has been one of the most important outcomes of the personnel research effort.

## THE SUPERVISOR'S ROLE

In planning the various areas of the research project, the steering committee initially had scheduled research in formal training for the last year of the three-year project, in the belief that the study of recruitment, screening, testing and job evaluation would emphasize training needs. However, it became increasingly apparent as the project got underway that supervisors in many areas of the hospital would require an intensive indoctrination in order to generate the maximum interest of all hospital personnel in a project with this wide a scope.

Supervisors would be expected to assist employees in completing their job-information reports for the job-analysis project, for example. Supervisors' recommendations were important in revising the experimental *Performance Appraisal Form.* Supervisors held the key for the prevention of excessive turnover, and, therefore, must be educated in the cost and significance of proper selection of employees.

It was, then, necessary to win the cooperation of the supervisory group if they were to accept the new tools and technics developed by the various research committees.

And again, the supervisor's role is prominent and important for the workers. After having been recruited and selected for each job, the worker cannot just be forgotten. He must be motivated—and his motivation will be the product of the total work situation and the attitudes of each individual. This "total work situation" includes the work climate which, in turn, is the result of organizational patterns, leadership, supervisory effectiveness, and the adequacy of communications up, down, and across. In a word, the supervisor on all levels is the key person upon whom depends the ultimate success or failure of a personnel program.

The supervisor has been delegated the authority to accomplish the work of a given area through others

in such a way that "both the workers and the supervisor derive personal satisfaction out of the work."[2] In addition, the supervisor must realize the basic objective of the hospital: optimum patient care. Management expects supervisors to carry out a host of duties and responsibilities for which the supervisors need a balanced mixture of social and scientific knowledge, skills, and attitudes—and which they ordinarily do not possess. For the most part, they have been promoted because of a demonstrated ability in their specialty.

But today supervision by chance is not enough.[2] To the necessary and desirable technical skill, supervisors must add the human and conceptual skill. It is both time-consuming and costly for management to allow supervisors to fumble in the performance of their jobs, or to acquire the necessary skills through trial and error. Not only will the supervisors' own performances be ineffective in this case, but both the production and morale of those whose work they are directing will be impaired.

## FORMAL MANAGEMENT DEVELOPMENT

Formalized management development for a total of 150 supervisors on all levels started in 1957 with a program emphasizing the basic supervisory skills of human relations, organization, management, and communications. Of the sixteen sessions given, human relations were highlighed in nine sessions.

Sister Miriam Eveline, assistant administrator, The St. Vincent's Hospital of the City of New York.

The aims of the program were:

1. To increase each individual's understanding of himself, both as a person and as a supervisor.

*a*) To enable each supervisor to see himself more objectively by comparing his attitudes with those of other supervisors, particularly in the handling of employees.

*b*) To better enable the supervisor to understand how his methods affect the workers whom he supervises, through discussion of good management policies and how he personally likes to be treated.

*c*) To emphasize the relationship of the supervisor's work to ultimate patient care through

the reorientation of each supervisor to his position in the total hospital structure. Each discussion group was constructed to include personnel from various departments of the hospital, thereby improving intradepartmental cooperation by both an awareness of some of the difficulties which each department faces and a fostering of consciousness of common problems.

2. To improve areas of communication between administration and supervisors.

3. To improve attitudes through group discussion. By opportunities for group discussion, supervisors are helped to appreciate that administration is interested in them, their development, and their problems. Under the leadership of trained group leaders, an opportunity was provided for ventilating negative feelings as well as for offering worthwhile suggestions. In the discussions, supervisors discovered that solutions were not easily arrived at—they became aware of the problems encountered in finding solutions acceptable to all.

## EVALUATION

In an effort to secure objective, quantitative data, two tests were administered during the first session of the supervisors' program: (1) *The Wonderlic Personnel Test,* and (2) *How Supervise? (Test B).** At the closing session, the alternate form (*Test A*) of *How Supervise?* was given as a post-test comparative study. Visual analysis of scattergrams of the test results revealed only one high correlation—between the scores on *How Supervise?* and those on the *Wonderlic Test.* This indicated (as do many other studies) that *How Supervise?* apparently measures intelligence, mental maturity and reading comprehension. There is probably also a measure of "knowledge of supervision"—but not of "supervisory insight," or of success in supervision. The comparative test served primarily as an exploratory instrument that revealed needs for further supervisory training.

During the final session the groups brainstormed on the value of sessions for potential supervisors and for self-satisfaction. Summarized results of the brainstorming sessions were relayed to each supervisor with a request for his assistance in evaluating them by picking out the five most worthwhile answers to the questions. (See Exhibit I, pages 32-33.) In evaluating the sessions, the participants demonstrated enthusiasm and acceptance, and detailed specific needs for continuing developmental sessions.

## SUPERVISOR'S RESPONSIBILITY IN EMPLOYEE RELATIONS

The next group of sessions was devoted to the supervisor's responsibility in employee relations. Con-

*The Psychological Corp.

ducted by the various members of administration, the sessions included discussion of personnel policies, with emphasis on changes (group discussions); how to communicate with employees (role-playing followed by group discussion); how to handle employee dissatisfactions or grievances (group discussion); motivation of worker (lecture); supervisory responsibility to plan, organize, and control ("buzz sessions"); and how to evaluate employee performance (small group discussions).

In this latter conference, the original experimental form which had been in use for twelve months was submitted to the supervisors for their evaluation, along with a statistical analysis of the use of the experimental form for their guidance. After four "buzz sessions," the suggested changes in the form were given to a steering committee—consisting of one department head and six supervisors, and chaired by a resident student in administration with previous experience in this area—for its study and recommendations.

After revision of the form along the lines suggested, it was accepted by the supervisors, the department heads, and the Administrative Council of the hospital, with the recommendation that it be used for a year, after a period of intensive training for all supervisors utilizing it, and then evaluated.

The conference method of group discussion was selected as the medium of development of supervisors in the use of the performance evaluation form, because research has shown that attitudes or behavior change more readily when people can participate, exchange ideas, and get the impression of other people, than when a straight intellectual approach (such as a lecture) is used. Factual material seemed less important to us than growth, development, and insight into supervisor-employee relationships.

Research has also demonstrated that change is more readily effected when active participation in the planning and execution is secured from those who will be involved in the change. Members of the line who are sold on the change will gain acceptance of it more readily than the expert staff member.[3]

Accordingly, it was decided to have those members of the steering committee who had demonstrated interest and enthusiasm in performance evaluation act as group leaders. This procedure was decided upon for three further reasons: (1) it would give a group of supervisors intensive training and experience in group leadership; (2) it would assist management in identifying potential leadership, as demonstrated in the execution of a job-training responsibility; and (3) it would broaden the base in training leaders if supervisors accepted development sessions by peer leadership.

**EXHIBIT I** **Most frequent suggestions made by 150 supervisors, after brainstorming sessions, to evaluate November 1957—March 1958 series of supervisory development conferences.**

**No. Times Suggestion Was Made**

*What would make these sessions more beneficial in the preparation of potential supervisors?*

29 Outline of the job to be given to each person promoted to a new position.
28 Make information concerning hospital problems available to supervisors before workers learn of it.
20 Need for employee to be directly responsible to one supervisor.
19 Knowledge of job descriptions on all levels.
17 More time on human relations.
17 Explanation of over-all policy and philosophy of the hospital.
16 Include courses in handling problems of supervisors.
16 Sessions to be given routinely before promotion to supervisory position.
16 Clearer understanding of departmental and interdepartmental communications.
15 More time on communications.

*How would you have arranged the classes if you had planned the program?*

22 More diversified personnel (as teachers.)
18 Human relations first.
17 Improve communications lecture.
17 More material from employee thinking as to job dissatisfaction or satisfaction.
16 Some type of counseling for specific problems either with group or private consultation.
14 Average of 10 people in discussion group.
14 General course with mixed groups at beginning and

special course for members of same department at end.

14 Less review of previous week's session and more new material.

12 Start giving the session to student nurses so they will know lines of administration.

12 More content on supervisory method.

*What else can we offer you in a development program?*

26 When someone is first hired, he should be taken on a tour of the hospital.

25 Periodic bulletin concerning what is going on in the hospital.

23 Good orientation before new policy is put into effect.

22 More sessions on supervisory problems.

21 Continuing opportunity for people from various departments to get together and discuss problems.

20 Wage and salary scales.

20 More sessions on human relations.

19 In-service education according to department.

19 Classes in supervisory methods.

18 Interview technics.

17 Formal course on the development of better supervisors.

16 Various meetings to settle difficulties among relating departments.

15 Course in legal aspects of hospital work.

15 Course on changes of policies and procedures and their effect on other departments.

15 Suggested English course for foreign employees.

15 Review classes in nursing in new procedure and technics.

*How has this course affected you?*

26 Will make me more tolerant in my future dealings with other departments.

25 Better understanding of administrative and interdepartmental problems.

23 Gives us a better insight of our own needs and attitudes.

23 Stimulates thinking about own reactions and responsibilities.

23 Very profitable—especially human relations discussion.

22 Fuller realization that whole hospital has one goal.

20 More awareness and appreciation of employee problems and a desire to solve same.

19 Gives us a better understanding of problems that confront management.

19 Stimulated desire for more relations—introduced me to other workers whom I didn't know before.

17 Greater appreciation and consideration of other problems in department.

17 It has been informative.

16 Made me feel that hospital was interested in employees.

16 Learned that every job was important from bottom to top.

16 Helps to make us better supervisors.

16 Shows need for knowing your own job better.

## CONFERENCE LEADERSHIP TRAINING

A type of intensive training was now needed in order to enable a group of supervisors to develop the skills and technics of good discussion leaders. The group members must learn to overcome or diminish the emotional blocks of self-consciousness and dependence; to acquire flexibility in approaching discussion problems; and to be willing and able to rely on their own judgment, imagination, and initiative. In addition, these supervisors had to overcome another problem in that they would be presenting material with which they had problems not completely resolved by the time they began leading the group. Their knowledge was mainly theoretical.

The training in leadership for the group was given by a psychologist on the school of nursing staff. Meetings were held weekly for five months.

The training leader first attempted to create an atmosphere of freedom in which the group might voice the fears they had in anticipating the discussions with supervisors. Solutions to some of the group's problems about performance evaluation were attempted through analysis and discussion. This gave an opportunity for the group to improve an operating skill by a deepened insight into performance evaluation; it afforded periods in which the teacher might demonstrate some of the technics and skills of leading a discussion; and it developed content for the discussions with the supervisors.

An entire day was spent by the group in practice sessions. Opportunity was given each trainee to lead the others on one of the sessions structured for presentation to the supervisors. Immediately following each practice session, a critique period was led by the training leader and the group analyzed what had happened and how the leader had felt during the period. It was decided that such a critique would be held after each of the actual sessions with the supervisors, in order to evaluate the content, the group participation, the questions raised, the problems encountered, and the reactions of the leaders. This would give the trainee an opportunity to review the skills and technics used or omitted.

## DEVELOPMENT IN PERFORMANCE EVALUATION

A total of 79 supervisors involved in use of the *Performance Evaluation Form* attended the performance evaluation sessions. A member of the trained group acted as a leader for each group of 16 supervisors. Interested department heads were invited to participate in a group chaired by the training leader psychologist, and three assistant administrators and eleven department heads attended.

The topics to be discussed were based on the problems which had been raised by the supervisors

as a result of their experience in rating employees on the experimental form. The resulting agenda included:

1. The benefits to be derived from the use of evaluation for the employee, for the supervisor, and for the total hospital in terms of patient care.

2. The orientation of the employee with respect to evaluation.

3. The mechanics of rating. What are the actual steps one takes in arriving at objective ratings of the worker's job performance? Are there norms of some sort?

4. Planning the evaluation interview in which the employee's job performance is discussed so that the interview will be most productive for both supervisor and employee.

5. Handling the evaluation of people who present certain problems—for instance, the very aggressive employee; the passive, dependent employee who will not participate; the worker with poor personal appearance or poor hygiene; the employee who seems to have adequate capacity but who learns slowly.

6. Handling evaluations when there are language barriers.

7. Method of rating employees who work evenings or weekends when the rater has no first-hand observation of their work. Rating of a worker when some of his tasks are never observed.

8. Lecture on performance evaluation by John P. Foley, Ph.D., covering reasons for rating, basis for rating (individual variabilities), pitfalls in rating, and objectivity in rating.

9. An evaluation of the program.

A summary of all conferences was given to participants the week following the specific conferences. This "Conference-in-Print" included both a digest of the material discussed and the more important questions raised by the participants. It was intended as a supplement to the discussions to be used as a manual on evaluations by the participants.

## RESULT OF THE DEMONSTRATION

The group leaders developed a sense of security through the sessions as they became more relaxed as leaders and more aware of the group. They began to realize they were not in the discussion role because they were experts who had all the answers. They found they were less concerned with themselves and more confident of their own abilities to cope with group problems. In the critique period following each conference they discontinued waiting for the training leader to start but began immediately, content to test their own abilities to reach solutions. The presence of an assistant administrator during these periods did not inhibit their problem solving and the assistant was used only as a resource person to answer questions of policy.

For a self-evaluation, four questions were asked the group. In response to the first question of *"What changes, if any, would you say occurred in your self-confidence as a discussion leader?"* all considered they had matured in this respect. One group member had been "literally terrified" at the outset, but after the first conference she became "more self-assured and secure." Another member summarized by adding, "I feel as if I could go on to new experiences in leadership with greater skill and self-confidence."

The second question asked was *"What changes, if any, would you say occurred in your ability as a discussion leader?"* One who had had previous experience in leadership with a homogeneous group on a professional level thought she had "learned more about leading and stimulating discussion in a group with greater diversity in background and experience. Diversity tended to point up the essence of supervision. This broadened my experience and knowledge considerably."

Another believed she had changed because "as long as I could convince my group of my sincerity and belief in the project, they regarded me not so much as a 'leader' but as a fellow-supervisor—someone they could talk things over with." Others considered the "direction and help an educational opportunity which was of great aid." Only one did not find herself in agreement with the directions for leaders.

The trainees were asked if the experience as a leader had helped them in their work as supervisors on the job, and if so, in what specific areas. They all thought the experience developed and clarified their own jobs since it enabled them to "identify with the hospital's aims and purposes" and therefore had "immeasurable value for supervisees." It had "widened the scope of understanding the employees' problems from the employees' point of view." It had "alerted me to many hidden problems which had never been brought out into the open"; and it had convinced the supervisors that "group technics are helpful in problem solving and work discussions." Specific areas mentioned included performance evaluation and pre-employment interviews, day-to-day relations with employees, conducting meetings, communicating with employees, and handling the aggressive or autocratic supervisor or employee.

Through an unsigned questionnaire at the last conference, the supervisors evaluated the leadership and the program. The questionnaire is summarized over-all as follows:

| | *Excellent* | *Good* | *Satisfactory* | *Poor* |
|---|---|---|---|---|
| Leader | 36.0% | 54.0% | 9.8% | .2% |
| Conference | 33.7% | 50.6% | 11.6% | 3.8% |
| Participants | 11.4% | 47.8% | 35.8% | 4.0% |

Although attendance at the conference was more or

less compulsory, two-thirds of the participants thought it had a "good" or "excellent" value; that it had increased their understanding of operating difficulties in other departments; that the conferences had applicability to actual work situations; and that there had been adequate coverage for each conference. Some 84 percent found the "Conference-in-Print" a valuable tool for rating purposes.

The leaders were judged "excellent" or "good" by 90 percent of the participants in knowledge of subject matter, and by 87.4 percent in ability to create a relaxed atmosphere within the group; but only 75.4 percent rated the leaders "excellent" or "good" in ability to elicit participation, and only 57.6 percent in ability to recognize and develop valuable contributions made by members.

A total of 70 percent considered the degree of interest and cooperation of participants "excellent" or "good" and underrated themselves as participants. This might tie in with the feeling that group leaders did not elicit participation to an "excellent" or "good" degree. However, in many instances the leaders had in their groups participants who had had more training and experience in discussion leadership than the leaders themselves. Hence, the overall rating of the leaders in 90 percent of the cases as "excellent" or "good" is an indication that the groups had accepted their peers as group leaders.

The 94 responses to the question: *"what specific areas or topics would you like to have included in future management development conferences?"* gives a wide range for future sessions and provides an opportunity to study other methods of presentation and training. (See Exhibit II, p. 38.)

In addition, the trainees were asked open-ended questions evaluating the program. These open-end questions offer a subjective description both of the changes participants consider as having been made in themselves and of the recognized areas for further improvement and development.

## FOR THE FUTURE

Appraisals provide more information about the appraiser than the employee. The appraiser's competence, knowledge, and personal characteristics should be considered in weighing the information. The overall quality of the appraisal-information provided should be a job-performance factor on which the appraiser himself is judged.[4] Hence, this group of sessions has given us many pertinent questions for the future. What additional development is needed by supervisors to increase their insight and objectivity in rating? What application of objective performance standards is feasible? How might a program of performance standards be implemented?

An objective evaluation of the results of the developmental sessions in changing the attitudes of the

**EXHIBIT II**

| Topics | Number of Requests | Percent of Responses |
|---|---|---|
| Management Principles | 23 | 24.4 |
| Delegation | | |
| Planning | | |
| Organization | | |
| Controlling | | |
| Leadership | | |
| Problem solving | | |
| Interdepartmental functioning | | |
| Supervisory process | | |
| Human Relations | 13 | 13.8 |
| Handling of different types of employees | | |
| Handling of problem employees | | |
| Human needs and their satisfactions | | |
| Psychology of behavior | | |
| Handling grievances | | |
| Handling of inter- and intra-department problems | | |
| Training | 11 | 11.7 |
| Development of employees' potential | | |
| Time-study | | |
| Cost analysis | | |
| In-service training | | |
| Principles of training | | |
| Orientation | | |
| Employee training in performance evaluation | | |
| Teaching and supervisory technics | | |
| Communications | 10 | 10.6 |
| Skills in communication | | |
| Interviewing | | |
| Conducting conferences | | |
| Oral and written communications | | |
| How and when to present questions | | |
| How to get action and definite responses | | |
| Job Standards | 7 | 7.4 |
| Objective methods of evaluating | | |
| Objective standards | | |
| Norms | | |
| Selection training | | |
| Selection interview | | |
| Valid testing | | |
| Methods of selection, transfer, promotion | | |
| Miscellaneous | 6 | 6.1 |
| Labor laws | | |
| Personnel policies | | |
| Wage, salary and promotional opportunities | | |

supervisors toward employees as individuals and toward their responsibilities as supervisors in training and evaluating employees is planned after the revised form has been in use for one year. The study will follow the method used in the report on the experimental Performance Appraisal Form.

## COMMUNICATIONS

Our present effort in development is in the area of communications. We are following with small groups the method and technic developed under a research grant by the Catholic Hospital Association —"Improved Communications Through Listening." Our supervisory staff has been most receptive of

this voluntary program. Since only groups of 15 may participate, those who have been selected for the first sessions have proved to be real public relations agents for the program and have advertised it widely. Its acceptance indicated there is a need for better communications, that the supervisory staff is ready and waiting for assistance, and that the program is very worthwhile.

## SELF-DEVELOPMENT PROGRAM

Supplementing the formal development program, an experimental self-development program for supervisors was also initiated. In this project, all supervisors received subscriptions to *Supervisory Management* magazine, published by the American Management Association.

The magazine was mailed to their homes and the administrator wrote a letter to each supervisor announcing the purpose and proposed evaluation of the one-year experimental subscription. A "guide," which related articles in the magazine to current supervisory problems and interests, was distributed each month at about the same time the magazine was received.

The acceptance of this method of development has met with varying degrees of success. About 73 percent wanted to continue the subscription and were willing to subsidize the cost.

## CONCLUSION

Development will never be a *fait accompli*. There will always be much to be done. Those who are engaged in management are dependent not upon personal work production but upon the production they are able to obtain from those supervised and the influence they are able to exert upon those with whom they come into contact. They are dealing with human beings, their behavior, attitudes, actions, and reactions. Leadership is a must.

A few men may be born leaders, but many more can benefit from a systematic program of developing the qualities essential to good management and to effective coordination and direction of the efforts of subordinates. This requires vision—a little of the "head in the clouds." It requires practicality—a great deal of the "feet on the ground." But above all it requires undaunted perseverance—the "stick-to-it-iveness" of purpose which is willing to try and try again.

Only when an organization is satisfied that it has accomplished its purpose in development, will it stagnate and lose ground. Development, like life itself, is a continuous process and is always beginning.


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# HOARDING AUTHORITY AND RESPONSIBILITY

By Don H. Scott

*Condensed from* Sales Management, *May 6, 1960*

In today's business, a *doer* is worth peanuts; a *developer* has unlimited value. The man who can distribute a great work load over many employees is on his way.

Unfortunately, we all have some "do-it-myself-because-my-people-aren't-competent-and-it's-easier" in us. In fact, a great number of managers are this way.

Two things contribute to this attitude: lack of knowledge and lack of courage. When managers are asked to analyze why other managers don't push responsibility down the line, the reasons often include:

Fear that employees will not do the job well enough or that their lack of know-how will reflect on the manager; belief that it is quicker to do than to teach; a feeling that employees don't do enough planning; a belief that the manager would be shirking his own responsibility, or that he should know everything going on in his section; fear that someone else will learn enough to threaten the manager's job, or that the employees already have too much to do; a belief that the employees are not capable enough to learn.

Then, when these managers are asked to list the advantages of passing down responsibility, this list results:

Frees the manager for creative work of planning and development; develops personnel; cuts costs because managerial time is more expensive to purchase; promotes higher morale—happier employees; sharpens decision-making because employees are nearer to the actual work being done and have quicker access to the facts; saves time because communication up and down the line is not necessary.

Mr. Scott is with Don Scott Associates.

The only logical conclusion is this: *decision-making should be pushed to the lowest level of the organization at which facts are available to make the decision.*

This puts responsibility on the manager, since "facts" must be not only in the form of data, but also in the form of know-how. The manager should know that to do a good job the employee must have two things: a thorough understanding of the job to be performed and the will to do it to the best of his ability.

The manager today has enough work just in guiding his enterprise through a maze of legalities without bogging himself down in details which someone else could do. Today's manager's biggest job is to contribute to constant improvement of personnel.

Fortunately, he can accomplish two things in one step: the mere act of pushing decision-making down is a development process, if done right.

That word "decision" seems to frighten a lot of managers. They picture personnel running off with the company. They seem to believe that chaos will result when this "decision-making" gets out of the manager's hands. The trick is that it never really does get out of your hands.

All authority flows from the man at the very top. His responsibility is the sum total of everyone's responsibility in the organization. He can never free himself from it. He can, and should, delegate work to those below him, in the form of assigned responsibilities. He is, in effect, merely breaking off chunks of his own responsibility and handing it to someone else.

But the manager, in turn, must also hand down commensurate authority. It is within this chunk of responsibility that the employee must be allowed to make decisions. And then he should be allowed to break off pieces and hand them down the line. The manager should make sure that the responsibility also carries authority in commensurate measure.

Most managers find that delegating jobs gets them done more efficiently than they could have done them themselves. For one thing, the employee down the line has more time. For another, he takes the job more seriously, since it is a bigger job to him and often represents opportunity—as it should.

Most trouble in the area of delegation stems from the manager's inability to understand himself. To develop your own managerial ability, work at seeing yourself as others see you. Make an honest attempt to blame yourself for any unfortunate occurrences in your division. Look back and see if you couldn't have forestalled the incident with better training of personnel.

All this is hard on the ego, but wonderful for making better managers. After all, taking the blame is one reason for your salary's being higher than that of those who work for you.

# Malpractice Suits: Causes and Prevention

Seventy percent of all malpractice suits originate from work done in a hospital, and two-thirds of all suits against physicians are in the surgical field, Joseph F. Sadusk, Jr., M.D., Oakland, Calif., declared in introducing a panel discussion on "The Law and You" at the eighth national AORN congress in San Francisco in February.

Some of the reasons for the great increase in malpractice suits in recent years, he said, are: articles on scientific advances in the lay press which cause the public to believe that anything less than a perfect result is evidence of negligence; increased hazards involved in the use of more complicated surgical procedures and new drugs and anesthetic agents; and the fact that the public is becoming "suit-minded" and the courts are becoming increasingly "plaintiff-minded."

Following are abstracts of talks by participants in the panel.

*The Administrator:*

## Patient's Welfare Always First Concern; Danger Areas for O.R. Nurses Listed

It is unfortunately true that a suit *can* arise out of the fact that the doctor or hospital was only doing the best for the patient. The medical staff and the administration of each hospital should establish the "do's and don'ts" of procedures based upon the welfare of the patient *regardless* of potential suits. The question should always be, "What is best for the patient?" not, "Will I be liable?"

Operating-room nurses are particularly concerned with the following potential sources of errors which may lead to malpractice suits:

*Consents or permits.* The operating-room supervisor certainly should have the authority to delay an operation if the proper consent forms are not completed.

However, she should have immediately available some assistance from the surgical or executive committee to make the final determination as to whether the surgery should proceed even though the proper consent is not signed. Too often she is left on her own, and in such a situation, she merely jeopardizes her future relationships with the medical staff.

*Patient Identification.* Most operating-room supervisors will say that patient identification is the final responsibility of the surgeon and the anesthesiologist. Though this may be true, the hospital and the operating-room nurse have had to assume their proportionate share of responsibility for errors in identification.

I believe that some one person—preferably the circulating nurse assigned to the specific case—should assume the responsibility of checking the chart and the wristband of the patient, for the patient's name, chart number, and doctor's name, and the specific procedure. Once an error has been committed, it is of no help to the patient for the nurse to say that the surgeon or the anesthesiologist should have known his patient.

A further complication that may arise from an error in patient identification is the use of the wrong type of blood for a patient requiring a transfusion. In studying many cases we have found that the anesthesiologist usually will rely on proper identification by the circulating nurse. I believe that she has the responsibility to properly identify the bottle of blood before passing it to the anesthesiologist.

*Instruments.* To my knowledge, 95 percent of the California hospitals are not doing any type of instrument count, on any procedures. In my opinion, either the instruments should be counted on every case, or counted on none. Some hospitals count instruments on only certain types of procedures. In other hospitals the operating-room supervisor will have an instrument count on a spot-check basis. This is dangerous. A jury might get the impression that the procedure is somewhat haphazard.

*Tissues.* Many hospitals do not have a positive control procedure for the handling and labeling of tissues, so that the tissue will move to the hospital laboratory and not be lost. There have been many cases in which tissues have been lost or mislabeled. Again, some one individual should assume sole responsibility for the proper handling of tissue.

*Anesthesia.* In a recent operation, the anesthesia (cyclopropane) had been completed and shut off, and the inhalant tube from the machine to the mask had been disconnected; yet somehow a spark was generated which caused an explosion in the exhalant tube and the patient's lungs. This type of explosive gas is heavy, and will remain in the tubes, and the patient, for quite some time. Therefore, the static electricity control cannot be dropped immediately

after the anesthesia has been stopped.—*George U. Wood*, executive vice-president, Peralta Hospital, Oakland, Calif.

*The Anesthesiologist:*

## Loose Talk May Destroy Patient's Confidence, Cause Misinterpretation

Loose or indiscriminate conversation in the operating room is one of the most potent sources of difficulty with patients. Many patients arriving in the operating room are apprehensive; a good many of them are suspicious, and are alert, in spite of attempts to medicate them and slow them down a bit, to everything going on, including the conversation.

Surgeons and operating-room nurses and anesthetists are a gabby lot, and are often inclined to make remarks, in the presence of these patients, that can be easily misinterpreted.

I think it's important also that the people in the operating room reserve their opinions or comments about other patients who had trouble with the type of anesthesia being used; comments to the effect that the symptoms experienced by the patient are different from the usual, or comments about the manner in which the anesthetic procedure is being performed or the use of a certain drug. Such remarks destroy some of the patient's confidence in the anesthesiologist.

At all times it's wise to express an air of confidence, and to avoid giving the impression of excitement, or of present or impending trouble. Acting in a calm, deliberate, reassuring fashion has a tremendously favorable impact on the patient.

Specific questions about the operation or the anesthetic should be referred to the physician responsible. Any expressions by the patient of dislike or actual rejection of any particular type of anesthetic should be reported to the anesthesiologist.

It's obvious that one should double-check on the drugs and the solutions that are being administered to the patient. One danger of which nurses are undoubtedly well aware is the similarity of many ampules and vials. It's important that everyone involved in the administration of a drug read the label and be certain that he understands what is being administered.—*Stuart C. Cullen, M.D.*, professor of anesthesia, University of California School of Medicine, San Francisco.

*The Surgeon:*

## Stresses Hazards in Transfer, Positioning, Importance of Sponge, Needle Counts

Though in many malpractice suits the hospital and the nurses are named as well as the doctor, more recently, it has been the tendency of the court to place blame on a single party rather than on joint responsibility.

Nurses, because of their ever-increasing skill and learning, are also made to assume greater responsibilities. For example, the courts are now apt to place sole responsibility on the nursing personnel for an incorrect sponge count, or for filling a syringe with the wrong solution. Nurses may even be held responsible when a needle has been left behind.

The importance of obtaining a properly signed consent before surgery has already been stressed by Mr. Wood. Some nurses may not know, however, that a male under 21 must have parental consent, whether he is married or not. A married woman 18 years of age or older can legally give her consent.

A child requiring emergency surgery can be operated upon, even though the parents cannot be contacted, if the doctor has obtained a court order. If the emergency arises at night, when it may be difficult to obtain a court order, it may be possible to perform surgery if three competent physicians sign a statement that it is a life-saving procedure which must be carried out.

If the parents are out of town, a telephoned consent is satisfactory if a second party listens in on the conversation and confirms this consent. As soon as possible, of course, the written consent should be obtained.

After the patient has arrived in the operating room, the first pitfall lies in his transfer from the cart to the operating table. We should make certain that enough personnel is on hand to transfer the patient gracefully, to avoid undue back strain or muscle strain or contusion to the body, particularly from apparatus attached to the O.R. table. Inept positioning of the patient can result in serious neurovascular injury. I refer specifically to tight bindings, to undue pressure behind the knee, and to pressure on the outer aspect of the lower leg, particularly near the knee, where there is the possibility of pressure on the peroneal nerve, with a resultant foot drop.

Conversation should be kept to a minimum, not only because of the danger of misinterpretation by the patient, but because of the hazard of infection, which may be caused by organisms sprayed from the respiratory tracts of members of the operating team.

To keep to a minimum errors in the sponge count, the use of the "four-sponge count" is most important. The first count comes when the packs are assembled.

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## Lost Sponge Found, to Hospital's Sorrow

What is a lost sponge worth? According to *The Regan Report*, it cost one hospital $35,300 when a Los Angeles superior court judge awarded damages of that amount to a patient who had required two trips to surgery to remove a sponge negligently left in his abdomen following an appendectomy.

You cannot rely upon the accuracy of the count on the package coming from the surgical supply house. The second count comes when the packs are taken down in the operating room; the third count is performed when the peritoneum is closed, and the fourth, when the skin is closed.

No buckets, linens, catheterization trays, hampers, and other containers should be removed from the operating room until the final sponge and needle count has been verified, because of the possibility that sponges may be deposited in them.

If it is necessary to change the nursing personnel during an operative procedure, an "on-the-spot" sponge and needle count should be carried out before the new nurse takes over the responsibility of an accurate count.

Some hospitals employ a specific needle setup and preoperative count. Perhaps a more practical approach is the "one for one" count. With this method, the scrub nurse will not hand up a second needle until the previous needle has been returned to her. Special care must be taken with the atraumatic or swaged-on needles, particularly if two or three of them are being used simultaneously.

Information on specific allergies to drugs, dressing preparations, adhesive and the like should be taped on the front of the metallic chart holder, so that it is visible to all O.R. personnel.

Moving the patient from the operating table to the cart again must be done with great care, because undue strains, particularly low-back strains and similar injuries, can certainly result in the anesthetized patient.—*Harry J. Peters, M.D.*, assistant chief of surgery, Highland-Alameda County Hospital, Oakland, Calif., and assistant professor of surgery, University of California School of Medicine, San Francisco.

"Retired surgeon."

## Immunity of Charitable Hospitals

*(From "Review of Hospital Lawsuits," a monthly feature of HOSPITAL TOPICS, by Leo T. Parker)*

In one of many recent decisions involving immunity of charitable hospitals to damage suits, a Michigan court ruled:

**"It is our opinion that a charitable, nonprofit hospital organization should no longer be held immune from liability for injuries to patients caused by the negligence of its employees. Our previous decisions holding to the contrary are hereby overruled."**

In other words, this higher court established a new law making charitable hospitals liable in damages for negligent injuries or death of patients the same as for all other hospitals.

As an example, in *Parker v. Port Huron Hospital, 105 N. W. (2d) 1,* the testimony showed that Port Huron Hospital was organized as a nonprofit institution, completely self-sustaining from an operating standpoint. Its policy was to adjust charges to patients from time to time to enable it to meet its operating expenses. The hospital corporation had operating revenues exceeding $1,000,000 annually, and had assets of over $1,808,000. The hospital originally was constructed by public subscription and government funds, and a recent sizeable addition was financed in the same way.

Further testimony disclosed that the hospital ordinarily was completely unrelated to the city of Port Huron and that many organizations such as the State Crippled Children Commission, St. Clair County Welfare Department, and Veterans Administration paid for the patients they sent to the hospital. In addition, the hospital received charitable contributions.

In a damage suit against the Port Huron Hospital it was shown that a thirty-one-year-old woman named Parker was admitted to the hospital for a total hysterectomy. Mrs. Parker's doctor made all the arrangements for admission and had charge of the case.

Certain preoperative preparations were administered to Mrs. Parker the evening of her admission, including blood tests by a laboratory technician to determine her blood type. The laboratory technician later testified she was tired and overworked and that in drawing the blood samples from Mrs. Parker she didn't mark the patient's name or identification on the tube while at her bedside—she simply dropped a slip of paper around the tube. This procedure was contrary to universal standard practice required in this and other hospitals.

On the same trip to Mrs. Parker's floor to obtain her blood sample, the lab technician had taken samples from two other patients. She returned to the laboratory with the three samples and began typing them, but was interrupted to do an immediate blood typing for a fourth patient. On returning to work on

the first three samples, she confused the sample tubes and the identification slips, and designated Mrs. Parker's blood type as A-RH positive—rather than the correct blood type of O-RH positive.

During Mrs. Parker's operation the following morning, she was given one unit of type A-RH positive blood while under anesthetic. The operation was completed and the patient left the table in apparently good condition. Three hours later it was discovered she was in severe shock and hemorrhaging badly "without a pulse and practically dead." Subsequently, she was again taken to surgery and there the laboratory technician's mistake in the blood typing was discovered. This mistake was reported to the operating surgeons. The record of operation shows that incompatible blood and mismatching of blood had caused hemorrhagic diathesis. As a result of the incompatible blood transfusion Mrs. Parker suffered a complete kidney failure or renal shutdown for a few hours, and died. The cause of death, as reported on the death record signed by her doctor, was "acute nephrosis (lower nephron syndrome) incompatible blood transfusion."

In subsequent litigation, the higher court *refused to hold the Port Huron Hospital immune to liability as a charitable hospital* and held the hospital liable in $20,548 damages to the husband of Mrs. Parker. This court said:

**"It is our conclusion that there is today no factual justification for immunity in a case such as this, and that principles of law, logic and intrinsic justice demand that the mantle of immunity be withdrawn. The old rule of charitable immunity was justified in its time, on its own facts. Today we have a new set of facts."**

## N.Y. Nurses Get Authorization To Give IV Procedures

A ruling handed down by Attorney General Lefkowitz of New York state authorizes that state's nurses to give blood transfusions, intravenous injections, infusions, and other IV procedures, under a doctor's supervision.

This ruling has clarified the state Nurse Practice Act to include intravenous technic as a professional nursing function.

**Q. Is an additional fee charged for night emergency surgery?**

A. In the overwhelming preponderance of hospitals, no additional fee is charged for night emergencies. One of the primary responsibilities of a hospital, and also one justification for the hospital's receiving continued assistance from the community, is the provision of standby and emergency services—*John G. Steinle,* writing in "Consultant's Corner."

# Stored Skin Maintains Viability for Delayed Autografts*

By Irving Feller, M.D. and M. S. DeWeese, M.D.†

Modern methods for the preservation of skin, first used by Alexis Carrel in 1912, have contributed to successful procedures for delayed skin grafting in wounds. Subsequent to Carrel, most of the literature deals with the storage of skin for homo-transplantation. In 1925, a technic was reported that delayed the application of split-thickness autografts for six hours after their removal. Since that time, methods of storing viable skin have been constantly improved.

The initial graft of split-thickness autogenous skin does not always take. When a large denuded defect results, the epithelization is incomplete. Pinch grafts used to cover the defect are also often unsatisfactory. The application of another continuous split-thickness graft is the most satisfactory method of covering the defect.

We have found that it is possible to reapply the split-thickness graft without subjecting the patient to another operating-room procedure. At the time of the original grafting, more skin is taken from the donor site than is needed for the initial graft. This surplus skin is then stored in the skin bank refrigerator and is available in the event the grafting procedure must be repeated.

*A report of the use of stored autografts by Drs. Feller and DeWeese first appeared in the Sept., 1958 issue of *Surgery*, and some of the material from that article is used with permission of the publishers, the C. V. Mosby Co.

†Department of Surgery, University Hospital, University of Michigan, Ann Arbor.

We have used delayed autografting procedures primarily for burn-wound cases, but the method has also been successful in treating defects caused by carcinoma surgery and cutaneous ulcers.

A standard procedure has been developed in the obtaining and storing of skin for autografting. We use four-ounce wide-mouth jars as storage containers for the skin specimens. These are the white opaque glass variety, used partly because they are easy to obtain, and partly because they minimize the effects of light on the specimens and the solution. Our supply room keeps a regular inventory of these jars and we requisition them as they are needed.

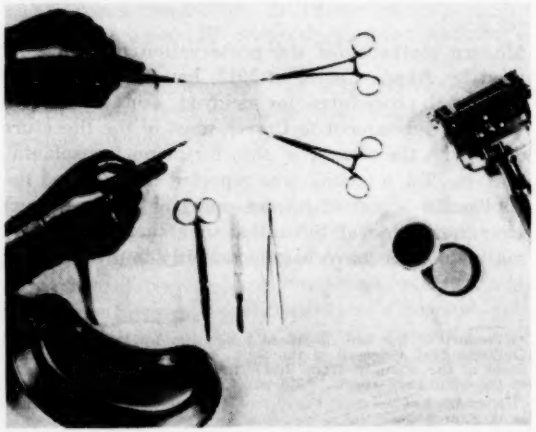
To prepare the jars for the grafting procedure, they are first packed with a sheet of instructions to the surgeon and the nurse dealing with the storage of the skin. The instruction sheet reads as follows:

Method for Storage of Skin Autografts

1. Obtain one-third to one-half more split-thickness skin than is required to cover defects.
2. Place cut surfaces together by folding specimen once.
3. Place skin on 4x4 sponge that has been moistened with Hartman's solution.
4. Roll sponge containing tissue and place in a sterile glass jar, available as "skin bank jars" in the supply room.
5. Label jar with patient's name, registration number, and date.
6. Add two ounces of "skin bank fluid," which is kept in the refrigerator, to the storage jar and seal with one-inch tape. Place jar containing specimen in the operating-room refrigerator immediately.

At the time of the original graft, the jar is opened, the instructions are removed, and the jar and lid are

At the time of the original grafting operation, an extra amount of skin is taken, prepared, and stored for subsequent use in a delayed autografting procedure.



sterilized. When the surgeon has removed the skin and followed the instructions, the "skin bank fluid" is added and the jar is placed in the refrigerator, and maintained at approximately 4° C.

The fluid used is a standard preservative medium used by others for storing skin, which has been altered to meet the particular needs of this technic. It is made up of the following, and is a modification of Hank's solution:

| | |
|---|---|
| Balanced salt solution (BSS) 10x | 80.0 ml. |
| Water for injection | 615.0 ml. |
| Normal human plasma irradiated | 200.0 ml. |
| Neomycin sulfate powder | 0.5 Gm. |
| Water for injection | 105.0 ml. |

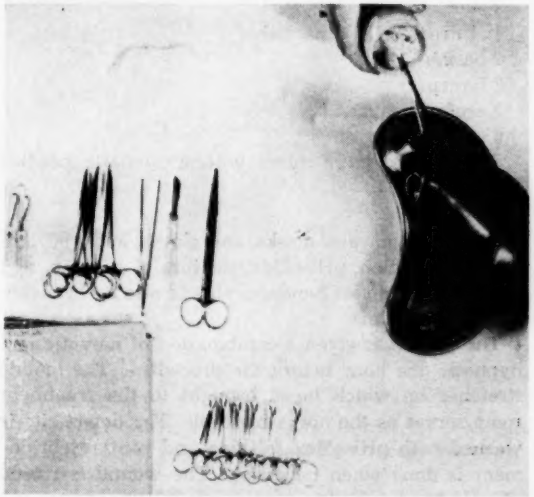
Aseptic technic is maintained throughout, and sterile equipment is used. A sterility test of the solution is run. The solution is then filtered into a sterile Erlenmeyer flask. The pH is checked (it should be 6.8), and the solution is emptied aseptically into 90-ml. sterile containers. Sterile stoppers are applied, the containers are inspected and capped, labeled "Skin Bank Fluid," and placed in the refrigerator.

We bottle the fluid in small containers for a reason. The entire contents of one of the containers is used in the storage of one specimen of skin. Other bottles are not disturbed, and asepsis is maintained.

The solutions are prepared by our hospital pharmacist. The plasma is obtained from the blood bank, and is separated from outdated whole blood.

If the preserved skin is not used within a period of two weeks, it is transferred from the operating-room refrigerator to the refrigerator in the skin bank. When a patient's initial autograft takes, and the extra stored skin is not needed, it is stored in the homograft bank for possible use in other patients.

At the time of the delayed autografting procedure, the preserved skin specimen is removed from the skin bank jar. Only basic instruments are needed for the grafting.



The recipient site is prepared for grafting. When the site is infected, preparation includes multiple dressing changes and saline soaks over a three to four-day period.

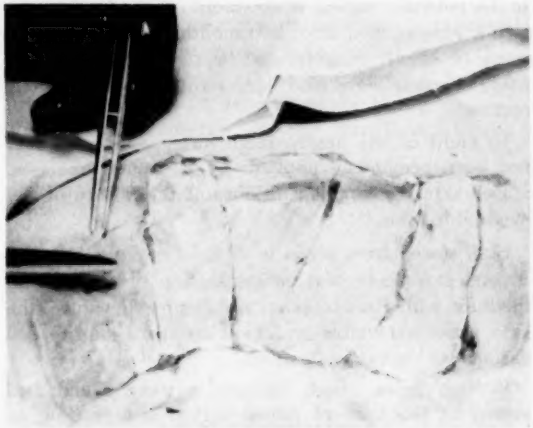
Application of the stored skin is carried out in much the same way as a primary graft. We have modified the operation somewhat to enable the grafting to be done in the ward treatment room, sparing the patient another operating-room procedure with general anesthesia. The following sterile supplies are placed on a large table:

4 sterile towels
4x8 dressings - 3 packages
cotton balls
4 hemostats
scissors
needle holder
scalpel
2 sterile sheets
4x4 dressings - 3 packages
2 basins
2 forceps
Xeroform gauze
6 towel clips
5-0 chromic gut sutures with atraumatic needles attached.

Sterile gown, caps, masks, and gloves, and 1,000 ml. Ringer's solution, pHisoHex, tincture of benzoin, and Ace and Elastoplast bandages should also be available for the procedure.

The patient is given a combination of narcotic and hypnotic one hour before the procedure. The mobile stretcher on which he is brought to the treatment room serves as the operating table. The defect site is washed with pHisoHex solution and gentle debridement is done when necessary. The wound is rinsed

with Hartman's solution. The field is then draped, and the granulation tissue is abraded with dry gauze to promote surface oozing. High granulations are trimmed off with a scalpel. Moist dressings are applied to the surface for approximately five minutes to achieve hemostasis.



Autografts in place, shown immediately after the procedure was carried out in the ward treatment room without general anesthesia.

During this time, the stored skin is removed from the storage jar and applied. It is not rinsed, but is ap-

Healed delayed autografts one month after application appear identical to fresh autografts.

plied immediately to the defect and trimmed to fit. Excess skin not used is returned to the skin-bank jar for subsequent storage.

If the graft involves an extremity, the graft is not usually sewed into position. If sutures are necessary, the use of 5-0 chromic catgut with an attached atraumatic needle is preferred. This type of suture, placed within 3mm. of the edge of the wound, causes little discomfort to the patient.

A single thickness of well-wiped Xeroform gauze is applied to the graft. Cotton balls soaked in Hartman's solution are placed over the gauze to provide even pressure. An occlusive dressing, reinforced by an elastic bandage, is then applied. Tincture of benzoin is recommended before the application of adhesive tape dressings. When the wound is near a joint, a light cylindrical cast is applied to immobilize the joint and promote healing.

The adaptation of this delayed autografting procedure to the ward treatment room has certain advantages. It frees the operating room for other work. It spares the patient another operating-room procedure, and from the pain involved in creating another donor site. The grafting can be accomplished in about 30 minutes, depending upon the experience of the surgeon, and the patient rarely requires anesthesia other than the narcotic already given. However, local anesthesia may be used in extreme cases. A trained assistant is not necessary for the procedure; the help provided by a nurse's aide has been found adequate.

We have found in our series of delayed autografts, that the percentage of "take" of the stored autograft was greater than that of the fresh autograft in six of 10 cases. This seems to indicate that the viability of the skin can be maintained by the type of storage used.

Eighteen stored cutaneous autografts were applied to 13 patients during a six-month period. The patients' ages ranged from two months to 75 years, and most of the lesions treated were burns, although other wounds were also successfully treated in this manner.

In eight of the grafts, fresh autogenous skin had not been previously applied. In the other 10 cases, stored skin was applied because of the failure of the original to take.

Skin stored from seven to 23 days remained viable. In one case there was contamination of the storage medium with *Pseudomonas* organisms; however, the skin remained viable and took on two separate occasions without complications.

In two cases, small autografts were saved and stored at the time of initial partial autografting of large burn areas. These stored autografts were reapplied in the operating room at the time of the next grafting procedure. At the final procedure for one of

the patients, skin was stored and later used to cover areas that did not take. This last procedure was carried out in the ward treatment room in the manner described.

Of the 12 stored autografts applied in the ward treatment room, one provided inadequate coverage, and further autografting was considered necessary. Follow-ups on all cases have been satisfactory for periods of three years or longer, and it has been noted that the sites covered by stored autografts are indistinguishable from those covered by fresh autografts.

A total of 47 autografts were stored from this group of patients. Twenty-nine that were not needed were either sent to the laboratory for tissue survival and bacteriology studies, or were transferred to the skin homograft bank if the segments were large enough.

Storage periods for the 29 specimens varied from one to three months. Microscopic sections were made in each case, and viable skin was found in the older specimens as well as those stored a shorter time.

A bank for cutaneous autografts can be useful to the surgeon. In addition to its use in the treatment of burns and other lesions described, the technic is applicable to other types of wounds as well. In patients with wounds resulting from trauma which cannot be closed or grafted primarily, skin for storage may be taken while the patient is anesthetized for initial debridement.

# Radiation and Chemotherapy, Cancer In Children Topics at ACS Sessions

*These abstracts are taken from papers presented at the nurses' program during the sectional meeting of the American College of Surgeons, held in Philadelphia in March, 1961. For other reports from this meeting, see pages 80 and 111.*

## Disturbing Side-Effects Caused By Hormones, Cytotoxic Agents

Side-effects of hormone therapy are disturbing for the patient. The skin may become coarse, the voice deepens, hair appears on the face and body, emotional changes are common. Nausea and vomiting, painful breasts, and excessive vaginal bleeding are all common to this therapy. Fluid retention, edema, and congestive failure are not uncommon.

A low-salt diet, strict intake and output, and daily weighing are all important.

When hormones are no longer helpful, the cytotoxic agents may be used. The nurse must know which agent is being administered and its particular toxic effects. Nitrogen mustard, for instance, causes nausea and vomiting and burning and slough if injected in the subcutaneous tissues.

The patient or someone in the family must be aware of the diagnosis and what the treatment involves. Though the patient may not be told all the finest details of her case, she should know the truth. She should have kindness, understanding, and an opportunity to talk about her illness.—*Nadine R. Landis, R.N.*, assistant director of nursing service, Hospital of the University of Pennsylvania, Philadelphia.

## Drawbacks and Potentialities Of Cancer Chemotherapy Considered

What can be expected ultimately of drug therapy for cancer is anybody's guess. It could eventually almost replace our conventional means of cancer treatment, or it may never be much more effective than it is at present. Judging from our progress

in the last few years, however, it seems to me that we have a good deal to look forward to.

Whatever we are planning to do to a tumor, it must not be something that the host cannot survive, nor should it be something which will interfere with any natural resistance the host may have to his tumor. On the other hand, it may be possible to modify the individual bearing of the tumor in such a way that the tumor finds a less hospitable environment in which to grow.

Though a cancer may seem to be a very abnormal type of growth, there appears to be little difference between the cells of malignant tissue and those of normal tissue as far as the chemical processes responsible for "life" are concerned. This tends to allow only a narrow margin of safety in attacking tumor cells with chemicals. Unless the drug can take advantage of some difference between normal and abnormal cells, it will simply kill them all.

An additional fact for consideration is the difference in growth rate of tumors. Many people live comfortably for long periods harboring widely spread and abundant tumor tissue which is apparently static; others die within a few months of the first appearance of their tumors. Evidently we do not necessarily have to destroy cancers; we may accomplish something worthwhile merely by slowing them down.

One of the most effective ways of modifying the tumor's environment is the administration of hormones, or the removal of glands producing them. Unfortunately, there is no general rule for predicting what kind of hormone to give, or whether or not any kind of hormone or gland removal will work. When this type of therapy is effective, however, one can expect that for about a year the tumor will be quiescent and may get smaller, and the patient will be essentially well. We have no idea why growth starts again, but it uniformly does.

To treat the large group of tumors which arise in organs which are not under any known hormonal influence as far as growth is concerned, if surgery and radiation have failed, we must turn to cytotoxic agents. These are frank poisons. We hope that they will be more poisonous to the tumor than the host, but we must expect the host to show some toxic effects if we are to get anywhere with the tumor.

None of these agents can be considered curative. At best they will improve things for a while. However, the fact that they work at all encourages us to think that they can be improved. If we could hold the line for very long periods, this would amount to almost the same thing as a cure.

The alkylating agents can be thought of as a basic molecule of some type—a "carrier"—equipped with a warhead which can fasten itself onto certain types of molecules which cells contain. Though the warhead must remain pretty much the same, the carrier portion of the molecule can be greatly changed. It is

hoped that such changes will produce drugs which are more powerful against tumors known to be sensitive to alkylating agents, or which will affect tumors that our current alkylators do not touch. These drugs are particularly useful in the management of leukemias and cancers of the breast and ovary.

The antimetabolites work in essence by imitating the molecular structure of some important substance so closely that they can displace it, without, however, doing its job. These agents are synthesized according to a preconceived plan, which must be arrived at by knowledge of cellular biochemistry. The more that is learned of biochemical processes, the more effective the antimetabolites are likely to be. At present they have been useful especially for leukemias, but 5-fluorouracil is also very promising for cancer of the breast and bowel.

Because all these chemical agents injure bone marrow and the lining of the gut, we are generally limited as how much drug we can give a patient. If we could find a way to protect these tissues, obviously we could give more drug and presumably get better effects from it.

Isolated perfusion of these drugs seems like an excellent method, provided that the tumor is pretty much confined to one area, and that its blood supply can be isolated so that the drug does not leak out into the main blood stream. For certain tumors satisfying these criteria, such as cancer of the cervix, perfusion may prove to be very useful.

In addition to the problem of toxicity, our other big difficulty is that cytotoxic agents tend to control the tumors they affect for only relatively short periods of time. Why tumors escape from control is not known; they may develop resistance, whatever this means, or they may contain different types of cells, some of which never were controlled in the first place. Possibly attacking the tumor with two or more different drugs, or with drugs and radiation, will help to delay relapse.—*Robert G. Ravdin, M.D.*, assistant professor of surgery, University of Pennsylvania School of Medicine, and director of neoplastic chemotherapy, Hospital of the University of Pennsylvania, Philadelphia.

## No Way to Predict Improvement With Specific Hormone Therapy

Hormonal agents help the tissues convert to a positive nitrogen balance; the patient's appetite improves, and general over-all improvement is significant. These agents are chosen for their specific action in dealing with cancer of the reproductive organs or the secondary sex organs.

The prototype is carcinoma of the breast. Prognosis is excellent if surgery is performed early. Some malignancies of the breast will grow and spread ac-

cording to the hormonal environment. Others are hormonally independent. Changing the hormonal environment of the host and tumor may affect the subsequent development of metastases or may produce some remission in the development of metastases.

There are no clues to the possible reaction to hormone therapy in the pathological specimen or the age of the patient. Whether the patient is premenopausal or postmenopausal is unimportant, but the absence or presence of the menses at the time the tumor appears is significant, and the fact that hormonal action continues for five years after the last menses must be considered. Because there is no way to predict improvement with any specific therapy, the simplest things are tried first.

With the first recurrence, the hormonal environment is changed with removal of the ovaries. This may discourage metastases for one to two years. Male sex hormones may be tried next, and with subsequent remissions, adrenalectomy or hypophysectomy may be considered.—*Sylvan Eiseman, M.D.*, associate professor of clinical medicine, University of Pennsylvania School of Medicine, Philadelphia.

## All Tumors in Children Considered Malignant Until Proven Otherwise

Cancer kills more children each year than any other disease. It strikes at any age, with a peak between 18 months and 4 years. Central nervous system tumors and lesions of the eye account for 30 percent; lymphomas, leukemias, 20 percent; flank tumors, 20 percent, and miscellaneous tumors, another 30 percent.

While adults have primary carcinoma—lesions arising from epithelial tissues—children have sarcomas—lesions arising from the connective tissues. The latter are difficult to diagnose. A mature woman may have a cancer of the cervix; it will bleed early and treatment will be prompt and curative. But a little girl with a lesion in the same area will not have carcinoma of the cervix but a cancer of the uterus. The first symptoms appear when it has metastasized to the lungs or when a large mass protrudes from the cervix.

All tumors in children must be considered malignant until proven otherwise. They must be biopsied, not by sectional biopsy but with excisional biopsy. There is no excusing the physician who sees a lump which he cannot explain and who ignores it as something that will eventually disappear.

Any recurring symptoms in children such as nosebleeds or girdle pain should be considered as possible signs of cancer.

Often there are symptoms which seem unrelated to tumor formation or which may mimic another more easily recognized disease. For instance, 13 patients with an ultimate diagnosis of neuroblastoma were admitted with the diagnosis of rheumatic fever.

Then, there is the group of children who have

nonspecific symptoms that take them to child-guidance clinics or ancillary problems such as the wound that does not heal after treatment of an abscess. This group must also be surveyed for possible malignancies.—*C. Everett Koop, M.D.*, professor of pediatric surgery, University of Pennsylvania School of Medicine, Philadelphia.

## Emotional Impact Great on Patient, Family, Nurses

There are problems with both patient and personnel in the care of children with cancer, the problems of physical care are great during the acute phase, but the emotional impact is even greater. The changes in the child's physical appearance are difficult to accept. It is most important that the nurse transmit to the child the idea that his appearance does not make any difference; that she does not reject him and that she will care for him no matter how he looks. Some nurses cannot help expressing their distaste for handling a baby with an ugly tumor.

Parents are also affected by physical changes. They bring in pictures of the child taken before the change to prove to the world that the sick child is not the original product. They remember the child as normal and healthy. Parents have a need to visit the child frequently and at odd hours which may give the nurse the feeling that they are checking on care. They ask often about the prognosis and may deny that the child is to die. They may insist that the laboratory studies are wrong or that pathology specimens were mixed. They may feel guilty and worry about heredity factors.

The parents must be allowed to express all these feelings, and the nurse must take into consideration the cultural differences in expressions. There seems to be some therapy in allowing parents to participate in the child's care, and reassurance seems to come from discussing the situation with other parents. It is difficult for them to watch another child with a similar affliction die, and they seem to have a great need to be present at the time their own child dies.

It is often difficult to know what to say to the parents of a dying child, and deeds can often transmit more than words. If the child is cared for with tenderness as well as efficiency; if there is a willingness to listen to the parents, the impression created is generally one of kindness and sympathy.

Despite a long program of excellent nursing care, parents often write a scathing letter after the child's death complaining about the quality of care.

Terminally, the child has great pain, and this is very difficult to watch. There may be profuse bleeding in children with leukemia, which is also difficult to see. Student nurses state the most distasteful period in their training is the time spent caring for the terminally ill or dying child. They become in-

volved emotionally. They function as mother as they care for the child, and the feelings evoked are different from those associated with adult care.

When a nurse reacts to the death of a child, she is reacting with maternal feelings. In long-term care, it is good if the child can be cared for by the same nurse, but this may be very traumatic emotionally for the nurse. She can express her feelings by crying or talking, and everyone should remember these are normal outlets which need only be handled so that the nurse's professional accomplishments are not diminished.

The death of a child affects a whole hospital unit. Depression overcomes everyone, and from time to time, the hospital community must be reminded that there are also successes in cancer therapy—*Erna I. Goulding, R.N.*, director of social work department, Children's Hospital, Philadelphia.

## Child or Infant Good Surgical Risk If Unique Characteristics Given Attention

One usually thinks of size as the distinguishing feature when discussing pediatric surgery in contrast to adult surgery. Actually, size makes little difference. It is the reaction to trauma of the surgical procedure that is markedly different.

The young child or infant has great resistance to this trauma. He comes through the surgical procedure well, and tolerates general anesthesia better than the adult. The cardiovascular system is flexible; there is great ability to withstand anoxia.

The newborn is the best surgical risk of all. He has his mother's physiology and an abundance of red cells, and seldom has complicating medical diseases. There is no rationale for postponing elective surgery in children. It causes the child to be brought up in a situation of handicaps. Furthermore, the best results are obtained with early repair of congenital defects.

The young surgical patient has remarkable powers of recovery if a few unique characteristics are given proper attention. In adults, volume of blood loss is considered, whereas in children, volume is substituted with "percentage" of blood. A loss of 30 cc. to the adult is negligible in terms of his total circulating volume, but in the newborn, this loss may represent frank hemorrhage. In a 6½-pound infant, 30 cc. of blood represents 10 percent of the total blood volume; in an adult, a 10 percent loss would be 900 cc. *(In experiments, the speaker stated that he went into hypovolemic shock with a loss of 750 cc.)*

Failure to understand the child's cardiovascular system may result in overloading him with intravenous fluids. Rate of flow is very important. The newborn can take great quantities of fluid if the administration is spread out over the day, but even a small amount run in rapidly can create a situation of overloading for the infant. When adjusting

intravenous equipment, it is imperative that no more fluid be in the container than the child could accommodate if someone should by chance open the drip flow to maximum flow.

Kidney function is not well developed in the first few weeks of life; the regulatory mechanisms of the endocrine system are not developed, and responses to stress are less well developed than in the adult. Because the respiratory system is poorly developed, an infant can respond to distress only by increasing the rate of respiration. An exhaustion phenomenon takes over, and death results. There is no diminution of rate; no prodromal symptoms of exhaustion. Suddenly, the infant takes a last breath and is dead. It is imperative to anticipate this distress and start treatment early.

Diagnosis in the young patient is difficult. Facts of history and physical must be obtained from the parents; certain signs elicited in the adult are lacking in the infant or newborn, and there is a major difference in psychological care. There is never the single patient to consider; there are always two parents and sometimes four grandparents, all with questions that must be answered many times and in great detail. Any surgical procedure on a child or infant is a major catastrophe to the family.

Anesthesia is the keystone to success in pediatric surgery. The technics of careful intubation; administration of cyclopropane to put the child to sleep without emotional trauma; the use of muscle relaxants; the effort put into making the hospital experience a pleasant one so that readmission will not be a source of dread—all these are essential features.

The technic of surgery is not as important as the timing. The size of instruments is not necessarily significant, since they must fit the surgeon's hands in any case. But tissue handling must be gentle in the most precise sense of the word. The least bit of edema in the tiny intestine of the newborn can result in catastrophic obstruction.

Dressings and bandages are omitted when possible. They only irritate the child, and the removal of adhesive tape is a painful experience that persists in the memory.

The team approach is absolutely necessary in treatment of the young patient. It would be impossible to anticipate any success in pediatric surgery without good nursing care. This has been made dramatically apparent in a study of mortality statistics in one clinic in which the organization of nursing units has made inroads on previously acceptable mortality figures for the newborn.

Adults have certain reserves in the postoperative period. If the intravenous infusion or the Wangensteen suction stops, it can be restarted with no serious complications. But in the infant or newborn,

these reserves are lacking, and postoperative care must be continuous with no lapses. Constant observation by the nurse is needed to anticipate or detect changes in condition and treatment.—*C. Everett Koop, M.D.*, professor of pediatric surgery, University of Pennsylvania School of Medicine, Philadelphia.

*The following abstracts are taken from* TOPICS' *report on the eighth national congress of the Association of Operating Room Nurses.*

## Chemotherapy, Excision

### Successful Skin-Cancer Therapy

As diagnostic procedures become more complete and accurate, and as our population gets older, skin cancers are being brought into prominence as a health problem. Age of the population is a factor, since skin cancers usually affect older persons.

Skin cancers constitute one in seven of all cancer cases among whites in the United States. Statistics from the National Institutes of Health showed 1947 figures of 40.4 skin cancers per 100,000 population, with a mortality rate of 2.4 per 100,000. This is a low mortality rate as compared to other types of carcinoma; however, there is a high rate of morbidity, and much disability and deformity.

In surgical treatment of skin cancers, early local destruction of the tumor is the only method of producing a cure. In excision, care must be taken to stay away from the tumor. It is extremely difficult to detect the tiny cords and nests in the cells. Frozen sections are used to demonstrate adequacy of removal.

Excision of a skin cancer leaves a considerable defect. We leave the defect open for a period of 18 to 24 months after surgery. After that time, plastic surgery is done, using skin of the face, neck, or chest. The defect is not repaired immediately because such repair tends to obscure the growth of new cancers and subsequent involvement of tissues.

In excision, care must be taken to make incisions along the normal lines of tension in the face. Reconstruction must be careful. A midline forehead pedicle is used in repair of the nose.

We have used chemosurgery in treating some individuals who have not responded to other therapy. This type of treatment allows us to follow destruction of tissue under microscopic control. The method destroys cancerous and normal tissue alike; it has no particular affinity for cancerous cells. However, the technic has been perfected to the degree that areas can be pinpointed so that little normal tissue is affected. Control of the depth of the treatment can be effected.

The chemosurgery treatment takes four days to complete, and presents considerable pain for the pa-

tient. Zinc chloride, 100 percent, is applied to the affected area. After 24 hours, the tissue is cut away. The tissue is examined microscopically, for residual tumor.

Both the patient and removed tissue samples are marked with dye. The process is repeated on succeeding days, and the tissue and patient are marked with another dye color. Pieces of tissue are sampled from the underside of the removed tissue, in repeated examinations for residual tumor. This treatment method has an advantage in that tissue is fixed without changing of the cells.—*Richard A. Shepard, M.D.*, Oakland, Calif.

## Adherence to Basic Technics Aids Carcinoma Patient, O.R. Staff

The basic technics involved in surgery for skin carcinoma are meticulous and time-consuming, but they cannot be rushed. The nurse must know the procedure—if she doesn't, it is up to her to find out from the surgeon. Much time can be lost waiting for instruments and supplies.

Ninety percent of our skin carcinoma surgery is done with a local anesthetic. Since the patient is awake, the surgical personnel must be particularly cautious about talking. A general rule to follow is to think carefully before speaking, and not to speak at all unless it is absolutely necessary. Aside from the danger of possible misinterpretation of conversation by the patient, quiet efficiency helps the patient's confidence. Working quickly—but not hurriedly—eases strain on both patient and staff.

Many of these surgical procedures are long. The patient must be made as comfortable as possible. The extremities must be supported and pressure on nerves must be avoided. Since we found patients complained about pain in the elbows when their arms were held straight under a sheet, we now tie the arms loosely to the rails of the operating table. This allows some freedom of movement, yet the patient cannot reach the operative field.

Soles of the feet should be well padded when the patient is in reverse Trendelenburg position. This is particularly important when general anesthesia is used.

Skin preparation is important. Any shaving of the area should be done before the patient is brought to the O.R. If shaving must be done in the O.R., all hair should be kept in one area and removed from the room. Eyelashes and eyebrows are not shaved, and hair is securely tucked under a cap, especially when the operative site is on the face or neck.

Ideally the small instruments needed for plastic surgery should be reserved for the plastic surgeons only. If this is not feasible, the nurse should make sure the mosquitoes are not used for Mayos, and the Webster-type needle holders are not used for heavy

needles. The tips of fine tissue forceps and skin hooks must be protected.

The nurse should know how to assemble and care for the dermatome used, whether electric or Padgett. The drum should be cleaned with ether before the cement is applied to it. Cement can be removed from the drum by simply rubbing it with a dry sponge. Ether should never be used to remove the cement—it merely dissolves the cement into the minute grooves of the drum. Periodically, the drum should be boiled in a 10 percent sodium bicarbonate solution to clean the grooves of all cement.

If a local anesthetic is being used, the nurse should check with the surgeon on whether he wishes to use adrenalin with it. This is especially important if a pedicle or flap is being shifted. The use of adrenalin in a flap or pedicle may constrict the vessels so that it may die from lack of a blood supply.

If two Luers are being used for anesthetic—one with adrenalin, one without—the syringe should be marked, and the circulating nurse should be apprised of the marking. I place a sterile rubber band around the barrel of the Luer containing adrenalin, and a needle in the supply on the table.

The type of dressings to be used should be ascertained. Fine mesh is used next to the wound because it does not stick. Either Xeroform, plain, or Owens fabric may be used. If the surgery is on the face and neck, the sutures are usually removed on the third postoperative day. Collodion gauze dressings are then applied. This takes the place of skin sutures and leaves no stitch marks.—*Avis D. Gibson, R.N.*, Dr. Shepard's office, Oakland, Calif.

## Correct Fixing, Labeling Methods Aid Surgical Pathologist

The surgical pathologist should work with the operating-room team as closely as possible in order to function smoothly in the taking and processing of surgical specimens.

In our hospital, the surgical pathologist processes specimens right in the O.R. suite, so that no specimens are carried out of the room and up a few flights to the laboratory. The surgeon receives the pathologist's diagnosis promptly, and in person; not over the telephone from a distant lab.

The pathologist's diagnosis can be influenced by what is done with the specimen after it is taken and before it reaches him. So it is essential that the specimen be handled carefully and in the manner that the pathologist recommends.

When biopsies are done, it is important for the surgeon to note the exact site. If several biopsies are taken, they should be labeled right, left, superior, inferior, according to numbers on a clock face, or with any other satisfactory system. The type of system used is not important, but identification of some kind

is essential. Identification of the biopsy site should be done immediately. If the surgeon waits too long, he can't remember exactly where six or seven specimens came from. The surgeon who simply states "a round piece from here, a square piece from here, and an elongated piece from there" has never looked at a specimen after it has been fixed.

After the specimen has been taken, it should be fixed immediately. Our standard fixing solution is 10 percent formaldehyde. If we wish to use another fixative, we supply it to the O.R. team and request that it be used.

When a hollow organ is placed, unopened, into fixative, diagnosis from that specimen is jeopardized. After such an organ is fixed, it assumes the general consistency of a garden hose and is almost impossible to work on. If possible, you might find an opportunity to nudge the surgeon into opening the specimen immediately, and placing it into fixative open.

Many specimens can be cultured, but there are instances when the only positive method of diagnosing a specimen is to use animals. If an infectious case is scheduled, and the surgeon suspects tuberculosis, you might be able to tell him immediately from the specimen that there are granulomas present which are compatible with tuberculosis, but the only sure way is to cut the specimen open, and either culture it or prepare it and inject it into a guinea pig.

Ten milligrams of tissue are all that is needed in examining for virus and rickettsia entities. This tissue we grind and inject into animals—*Livia Ross, M.D.*, executive secretary, tumor registry, VA Hospital, Oakland.

"The patient is a hypochondriac—she lives for the suture."

# Notes on Technics of Intramuscular Injection*

By Samuel Zelman, M.D.**

Intramuscular injections, like many other technical procedures, were originally administered by physicians but have been largely taken over by the nursing profession. This is as it should be, for the physician would be greatly limited in his effectiveness if he were required to administer these himself.

Being no longer familiar with the technical details of the intramuscular injection, physicians may be inclined to treat them perfunctorily. Such an attitude, innocently acquired by nurses, may lead to improper practices of that technic, with resulting unnecessary pain and morbidity to patients. Patients rarely complain of the pain inflicted, for they tend to assume such suffering to be a necessary part of the procedure.

Prior to the introduction in 1945 of penicillin therapy, physicians were well taught and practiced in the technic of intramuscular injection by virtue of their experiences in the syphilis clinics. The injection of irritant bismuth or mercury salts required a meticulous technic to avoid disaster. Such a technic was described by Stokes, whose comprehensive textbook of syphilology devoted seven pages to a discussion of the choice and care of needles, eight pages to the technic of intramuscular injection, and four pages to

*Reprinted with permission from the May, 1961 issue of *The American Journal of the Medical Sciences* (Vol. 241, No. 5), published by Lea & Febiger. With the author's approval, the parts of the original article which contained his analysis of results of a questionnaire to evaluate teaching practices have been condensed and combined with the tabulation of replies received, shown in Table 1.

**Dr. Zelman is assistant chief, medical service, VA Hospital, Topeka, Kans., and lecturer in internal medicine, University of Kansas School of Medicine, Kansas City, Kans.

the prevention and treatment of complications of intramuscular injections (Stokes, Beerman and Ingraham[9]). It is surprising how scant are the descriptions found in textbooks of nursing.

Being employed full time in a hospital, I have often observed errors and omissions in the technic of intramuscular injections administered by nurses. In my experience, nurses have taken kindly to correction, and have many times told me that their teaching had not included all such details of technic.

To test the generality of the truth of such a statement, a questionnaire (Table 1) was submitted to the 108 nurses employed at this hospital. The 101 replies which were received proved disturbing in their near universality of error and omission and in their reports of the inadequacy of their teaching. This is probably a representative experience, since our nurses were educated in 55 different nursing schools located in 23 states.

**Site of Injection** (Fig. 1—2). The upper outer quadrant of the buttock is the site of choice in the traditional method of intramuscular injection. This quadrant allows a maximal thickness of muscle to receive the injected material, so that it may be deeply injected. It avoids the blood vessels and nerves which are present in profusion in the upper inner quadrant, and the great sciatic nerve in the lower inner quadrant. No other quadrant of the buttock is acceptable. Injections into the deltoid or other muscles are less satisfactory, because of the thinness and greater sensitivity of these muscles, and the proximity of vulnerable nerves.

The greatest hazard to which the intramuscular injection into the buttock is subject is injection into or near the sciatic nerve in the lower inner quadrant. Shaffet[7] made a careful study of the anatomy of the gluteal muscles and the distribution of intramuscularly injected substances. He found that injections into the lower central portion of the buttock endangered the greater sciatic nerve if they extended through the gluteus maximus muscle. The more common and temporary sciatic-like pain extending down the back of the thigh he attributed to irritation of the small sciatic nerve which lies immediately over the great sciatic nerve in this area. Injected fluid was well dispersed within the first few minutes, assuming a curved linear distribution within the gluteus maximus, being closely confined to the coarse fasciculi into which this muscle is divided.

The frequency with which injection into or near the sciatic nerve occurs may be gauged by the replies to item 7a in the questionnaire, in which seven or

Fig. 1. (Opposite). Steps in the traditional technic of intramuscular injection into the posterior gluteal muscles. (Reproduced from Stokes, Beerman and Ingraham[9] with permission of the authors and publisher.)

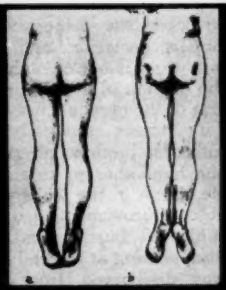


Fig. 1 - a "Toed-in" to show relaxation of the buttock. b "Toed-out" with dimpling of buttock indicative of a tense musculature.

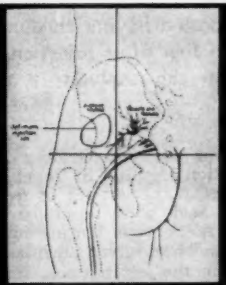


Fig. 2 (After Shaffer). Other sites than the gluteus maximus may be employed for intramuscular injection, including the infraglenoid muscle and the deltoid, but these are relatively unsatisfactory both on the score of slow absorption and materially increased pain.

Fig. 3. Left hand drawing down the buttock.

Fig. 4. Introduction of the needle.

Fig. 5. Aspiration to test for presence of the needle in a vein.

Fig. 6. Injection, the emulsion or solution should flow as freely and not have to be forced

Fig. 7. On release of the left hand the tissues of the buttock return to their normal position, producing a valve action. This emulsion is spread out in the muscle tissue and leakage prevented by persistent massage with a cotton pledget. The massage may be prolonged to five minutes or more by the patient

eight percent of the nurses reported having encountered pain or numbness in the foot after injections. Two brief case reports illustrate the morbidity produced by this hazard:

*Case 1:* A 37-year-old man was admitted October 2, 1957, to the Veterans Administration Hospital in Topeka, complaining of pain and weakness in the left leg of five weeks' duration. In August, he had been hospitalized elsewhere for one week because of nervous tension following a bout of alcoholism. He had been given an intramuscular injection of Thorazine in the left buttock. Immediately following the injection, the left foot became numb, and he fell to the floor. Since then, there had persisted severe pain and a burning sensation of the anterior aspect of the left leg and foot. Diathermy and vitamin therapies had been used. The weakness had begun to improve at the time of admission to the Veterans Hospital.

The left Achilles tendon reflex was absent, and there was inability to dorsiflex the left foot and toes. Severe weakness was demonstrable of the flexor hallucis longus, tibialis posterior, and gastrocnemius muscles. Sensory loss was present over the lateral aspect of the left leg and the dorsum of the left foot, corresponding to the distribution of the peroneal nerve.

Treatment consisted of more vitamins, an extension splint for the foot, physiotherapy, adrenal steroid therapy, and hypnotherapy to aid in relaxation of secondary muscle spasm in the leg. By the end of November, considerable improvement had occurred in motor power, but subjective burning and pain continued thereafter, finally disappearing at the end of April, at which time the patient was discharged from the hospital. Examination then showed intact Achilles reflex, and no remaining sensory loss.

*Case 2:* A 59-year-old man was admitted July 14, 1959, to the Veterans Administration Hospital in Topeka, complaining of numbness and pain in the right foot, of two months' duration. He had been hospitalized elsewhere April 9 to May 8, 1959, having entered because of hemorrhoidal bleeding but having been kept hospitalized for

**Table 1. Questionnaire Submitted to Nurses, with Tabulation of Replies Received**

*(Summaries of author's comments appear.)*

To All Nurses:
Your cooperation in answering this questionnaire is requested in order to evaluate teaching practices in regard to the technic of intramuscular injection into the buttock. You need not sign this questionnaire.

1a. In administering intramuscular injections into the buttock, do you use the upper outer quadrant?
Always 92 Not Always 9

1b. Were you taught the permissibility of use of other quadrants?
Yes 18 No 82 Unanswered 1

[*Five of the nine nurses who said they did not always use the upper quadrant were among the 18 who said they were taught that the use of other quadrants was permissible.*]

2a. Do you administer such injections in the prone position?
Always 45 Not always 56

2b. Were you originally taught to insist upon this position only?

Yes 47 No 53 Unanswered 1

[*Of the nurses who did not always use the prone position, 12 had been taught to insist upon it, indicating the frequency of lapses from properly taught procedure when the subsequent environment proves indifferent.*]

3a. Do you ask the patient to "toe in"?

Always 12 Not always 84
Unanswered or questionmarked 5

3b. Were you originally taught to have patients "toe in"?

Yes 10 No 86 Unanswered 5

[*Among the 89 who did not always ask patients to "toe in" were three who wrote in, "Never!" These three responses —and the five omitted or questionmarked—probably indicate total unfamiliarity with this part of the technic.*]

4a. Do you draw down the buttock before inserting the needle?

Always 58 Not always 43

4b.Were you originally taught to draw down the buttock?

Yes 46 No 53 Unanswered or questionmarked 2

[*Of the 43 who did not always perform this maneuver, one wrote she made the skin taut instead, apparently confusing this maneuver with the technic used in subcutaneous injection. One nurse reported she had been taught to "draw down on a thin patient, pinch up on a heavy patient." The "pinching up" maneuver would be likely to increase the hazard of injecting near the sciatic nerve.*]

5a. Do you aspirate for blood prior to injection?

Always 97 Not always 4

5b. Were you originally taught the necessity for such aspiration?

Yes 94 No 7

[*The importance of this maneuver seems to be well known and properly taught, perhaps because the reason for its performance is more self-evident than are those of other details of the technic of intramuscular injection. Of the nursing texts examined, more made reference to this maneuver than to any other specific detail of the technic.*]

6a. Do you massage the injection site after injection?

Always 72 Not always 29

6b. Were you originally taught to massage the injection site?

Yes 81 No 14 Unanswered 1 "Sometimes" 5

[*Of the five who wrote "Sometimes," four added that "it depends on the medication." The same answer was given by one of the 29 who did not always massage the site.*]

7a. In your experience, have any patients ever complained of pain or numbness in the foot after injection?

Yes 7 No 93 Questionmarked 1

7b. In your experience, have any patients developed painful lumps persisting for days after injection?

Yes 48 No 51 Questionmarked 2

[*This is an unnecessarily high frequency of such lumps. Six of the nurses added that the lumps had followed repeated injections. Three nurses said that they had followed certain medications; one blamed them on "poor circulation." Thus do faulty technics persist, while their effects are blamed on other causes.*]

neurologic study following the occurrence of a grand mal seizure. During that hospitalization, he had received many intramuscular injections, usually in the right buttock. These were given, according to the patient's story, in lying or standing positions, and in outer or inner aspects of the buttock. Following some of these injections, the patient developed lumpiness and tenderness in the lower inner quadrant of the buttock, pains down his right leg, and numbness of the right foot.

Chronic disabling pain in the right foot began May 5, three days before the discharge from the hospital. In the next two months, the patient was attended by his home physician. Initially, pain involved the plantar area of the foot, and extended to the calf of the leg, posterior thigh and hip. Improvement occurred during the second month. At the time of rehospitalization, pain and numbness were residual only in the foot. Tingling occurred on walking or on contact against the foot. Pain was not accentuated by walking, but tended to be worse during the night. There were no sensations of temperature change.

Examination revealed weakness of the right Achilles tendon reflex, but no muscular atrophy was detected. Pinprick sensation was intact, but resulted in marked tingling and muscular movements of the foot. There was absence of touch sensation on the medial aspect of the base of the right great toe. The right foot was warmer than the left, despite a weaker dorsalis pedis pulse. The left leg showed no sensory disturbances.

During his hospitalization, lasting 11 days, the patient continued to improve, and he was discharged with reassurance of continued improvement.

**Position of the Patient** (Fig. 1—1). The intramuscular injection should be given with the patient in the prone position, toes facing inward and heels outward. Pointing the toes inward and heels outward causes gluteal muscle relaxation, automatically maintained by the patient. This position is preferred to the position designed to achieve relaxation which is advocated by some authors (Dutton and Lake[1]), in which the patient lies prone with the head turned to one side, the arms hanging over the sides of the treatment table or bed, and the knees bent with a pillow under the shins supporting the legs.

Standing or sitting positions have been described, but add increased hazards. The patient may make a sudden jerking movement at the time of painful entry of the needle. My only personal experience of a broken needle occurred during injection in the sitting position, when the patient made a sudden rising movement on insertion of the needle; incision and probing under the fluoroscope were necessary.

In the standing position, proper relaxation of the gluteus muscle may not be achieved, or the muscle may be sharply contracted on entry of the needle. Injection into a contracted muscle is painful, because the sensory innervation of muscle consists predominantly of pressure-sensitive nerve fibers rather than pain-sensitive fibers. The contracted muscle may fail to accommodate the injected solution, tending to force it back along the track of the needle and into the subcutaneous tissue. The dangers of subcutaneous leakage of injected solution are discussed below in relation to length of needle.

**Length of Needle.** The needle should be long enough to reach well into the belly of the muscle. Otherwise, there is danger of injection into deep subcutaneous tissue. This point was not included in the questionnaire, but I have repeatedly discovered nurses using needles of inadequate length. Such instances usually come to my notice after a patient has complained of persistent painful deep subcutaneous nodules (Fig. 2).

Many medications require intramuscular injection solely because of the greater pain caused by them if injected subcutaneously, due to the greater subcutaneous sensory innervation. Other medications are injected intramuscularly because of the need for more rapid absorption. Slower absorption in the subcutaneous tissue not only defeats the requirement of more rapid systematic effect, but also allows greater tissue reaction to the irritant qualities of the longer persisting medication, leading to persistent painful encapsulated nodules or "sterile abscesses."

A needle of 1" length is never adequate in any but emaciated adults, while a needle of 3 or even 4" length may be required in an extremely obese person. Usually, a needle of 1½, 2, or 2½" length will suffice.

Shaffer[7] produced radiographs of subcutaneous leakage following intramuscular injections of iodized oil, finding that such leakage could be readily prevented by using a needle of small gauge, by drawing aside the skin and subcutaneous tissue of the buttock prior to injection, by making the injection well within the muscle, by leaving the needle in place a few moments on completion of injection, and by applying

Fig. 2. Painful inflammatory induration ("sterile abscesses") of the subcutaneous tissues of both buttocks following multiple injections over a period of one week. Breakdown of skin on the right side has resulted in seepage and crusting of exudate.

Fig. 3. Radiograph showing subcutaneous leakage and nodule formation following injection of iodized oil into the gluteus maximus muscle. (Reproduced from Shaffer with permission of the author and publisher.)

pressure with a cotton pledget immediately on its withdrawal.

On the other hand, subcutaneous leakage could be deliberately produced by using a large (20-gauge) needle and withdrawing it quickly on completion of the injection, without making any effort to secure the valve action of the skin by pulling it to one side prior to injection. The Roentgen-ray film clearly showed the point of injection slightly within the gluteus maximus muscle, the line of leakage with its collection into a ball-like deposit in the fatty superficial fascia, and extension of the jagged line of leakage to the skin surface (Fig. 3).

**Introduction of the Needle** (Fig. 1—3, 4). The important part in introducing the needle is the maneuver of retracting the skin and subcutaneous tissues. Theoretically, at least, when the needle is later withdrawn the return of these superficial tissues to their normal positions serves to break the direct needle track, thus decreasing the likelihood or quantity of subcutaneous seepage of injected material from within the muscle belly. A more important function, perhaps, is served by the tactile knowledge thus imparted to the nurse of the approximate location in depth of the firmer muscular tissue underlying the movable subcutaneous mass.

**Aspiration** (Fig. 1, No. 5). This maneuver is designed to test for accidental entry of the needle into a

blood vessel, and is necessary to avoid intravenous (or intra-arterial) instead of intramuscular injection. Many medications designed for intramuscular use would be dangerous if introduced into the bloodstream. Aspiration should continue for five to 10 seconds, particularly with narrow-gauge needles. If blood or any other fluid is obtained, the needle is withdrawn and another injection site chosen.

**Injection** (Fig. 1, No. 6). A slow rate of injection allows time for distention of an accommodating space within the muscle, sparing the patient the pain sensations of the pressure-sensitive nerves within the muscular tissue. In my observation, more frequent even than a hasty rate of injection in causing unnecessary pain is the failure to have the patient "toe in" to relax the gluteal muscle. A contracted muscle cannot receive the intramuscular injection without marked increase in pressure, producing both pressure pain within the muscle and painful subcutaneous leakage outside the muscle.

A bubble of air in the syringe barrel held upright provides the means for clearing the needle of medication before withdrawal, thus reducing the dripping trail of medication through the subcutaneous tissues on withdrawing the needle.

**Massage** (Fig. 1, No. 7). Deep, firm massage of the muscle tissue favors spread of the medication through a wider area of tissue, increasing the area of absorption and decreasing the intensidy of discomfort. Massage should be performed with the muscle relaxed by the "toed-in" position, for massage of a contracted muscle may increase subcutaneous leakage.

The importance of massage in relation to diminishing pain or discomfort will vary with the quality of medication used; but for the purpose of providing a wider surface for absorption massage is an important part of all intramuscular injections. Even slowly-absorbed depot material requires an absorbing surface, all the more so to prevent pocketing and walling-off by tissue reaction.

### The Anterior Gluteal Injection Site

A simpler and safer method of intramuscular injection has become available with the introduction in 1954 by von Hochstetter[2], at the Anatomical Institute of the University of Fribourg in Switzerland, of a new area of choice for intramuscular injection, the anterior gluteal region. In 1955, von Hochstetter published a detailed review[3] of the extensive literature which has accumulated on the damaging effects of posterior gluteal injections, and analyzed their causes. The anatomy of the posterior gluteal and of the new anterior gluteal injection sites was detailed in a subsequent paper[4], in which an extensive favorable experience with the new injection site was reported.

Figures 4 and 5, adapted from von Hochstetter, indicate the anatomical localization of the anterior gluteal injection as seen in frontal and obliquely horizontal body sections.

The anterior gluteal region actually provides a greater thickness of gluteal muscle into which to inject, consisting of the gluteus medius and minimus muscles, rather than the gluteus maximus muscle found posteriorly. No significant penetrating nerves or blood vessels are found in this area, which is served by multiple small nerve and blood-vessel branches. At its depth, it is sealed off by bone from underlying

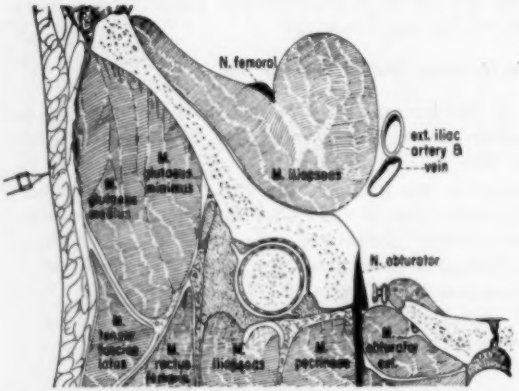



Fig. 4. Frontal section through right half of pelvis at site of ventral gluteal intramuscular injection. Position of needle is indicated. (Adapted from von Hochstetter[4].)

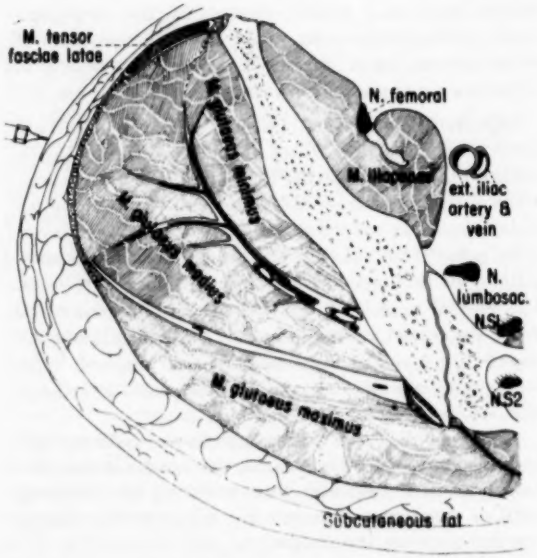



Fig. 5. Cross-section through left half of pelvis, from anterior superior iliac spine to posterior inferior iliac spine. Position of needle at ventral gluteal injection site is indicated. (Adapted from von Hochstetter[4].)

vital structures. The direction of the muscle bundles is such as to prevent a run-off of injected material toward the sciatic nerve, in contact to the gluteus maximus muscle bundles of the posterior injection site.

The layer of subcutaneous fat in the anterior gluteal region is always thinner than that over the posterior buttock, thus reducing the hazard of subcutaneous deposit of medication by short needles. Furthermore, the subcutaneous tissue is looser here, allowing its thickness easily to be determined by raising a skin fold. It is a cleaner area, freer of fecal organisms on the skin surface. It can be readily localized by palpation of available bony markings by simple maneuvers. It can be used in any body position, and is especially suitable for use in patients lying on their backs.

Schmidt[6], at the University of Basel in Switzerland, in a comparative study found the new ventral gluteal injection site preferable to the traditional posterior gluteal site. Despite accurate technic, posterior injections with dye into cadavers resulted in some subcutaneous deposits, while none followed anterior gluteal injections. In deliberate attempts to misdirect injected dye, using a needle 8 cm. long, he found direct damage of greater vessels or nerves to be impossible from the anterior injection site, though lesser nerve branches could be reached. Comparing 500 injections of each of the two types in both ambulatory and hospitalized patients, he found that the intensity and duration of pain induced was approximately the same for the two methods.

The anterior gluteal injection site is readily localized by palpation (von Rechenberg and Schmidt[6]), as shown in Fig. 6. The anterior superior iliac spine (actually a bossy prominence at the junction of the iliac crest with the medial vertical border of the iliac bone) is identified, and the tip of the index finger rested on it. The adjacent third finger is widely abducted (to form a V with the index finger as in the Swiss oath or in Sir Winston Churchill's V-for-victory sign), and its fingertip finds the crest of the ilium in order to slide just below it and rest there. As the palm of the hand then rests on the lateral aspect of the anterior pelvic region, the site of injection is unmistakably outlined by the confines of the triangle formed by the V of the two fingers and the horizontal ridge of the iliac crest above (Fig. 6, p. 78).

A right-handed nurse injecting into the patient's left side will reverse the positions of the two fingers of the left hand, placing the third finger on the anterior superior iliac spine and the index finger just below the iliac crest laterally. In very obese patients, it may be necessary to lift the abdominal panniculus upward and medially away from the injection site;

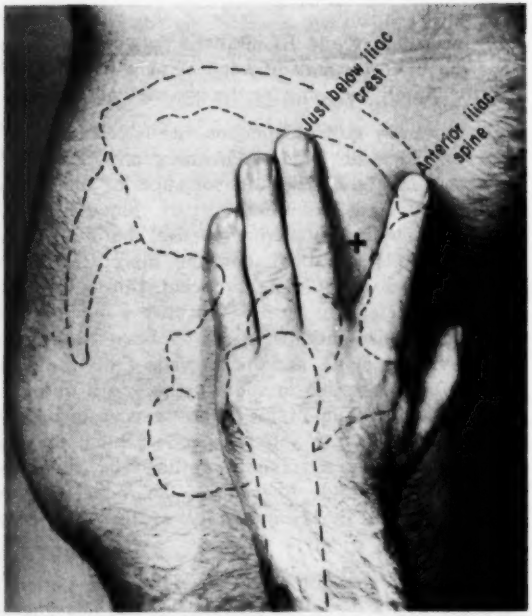



Fig. 6. The two-fingered technic of localization of injection site for ventral gluteal intramuscular injection.

this is easily done by the patient or an assistant.

The needle is thrust through skin and muscle in a single movement, pointing slightly toward the head to a depth of 3 to 4 cm. (1-1½″), and the medication injected slowly, after first aspirating for the rare possibility of having entered a blood vessel. If the needle should be pointed too far cephalad, it is apt to encounter bone, in which event the needle is withdrawn partially before injecting. The technic is simple and easily learned.

The method of anterior gluteal intramuscular injection was introduced into the wards of the medical service at this hospital in May, 1959, and has been used routinely since then. Having learned the simple technic, nurses quickly became enthusiastic over its advantages in not having to turn patients and in the marked reduction of the number of details of technic required by the posterior gluteal injection. With increased experience, they became accustomed to the absence of sequelae in the form of painful subcutaneous indurations, patients' discomfort in lying on their injected buttocks, and tingling nerve injuries involving the legs.

Although an energetic program of teaching and encouragement was required to establish the new technic on the wards of the medical service, its spread through the remainder of this large hospital was initiated entirely by the nursing service as a result of the enthusiasm of the nurses of the medical service.

In nearly two years of experience with this method, we have encountered no morbidity. Pain, as Schmidt

found, is about the same as in posterior gluteal injections, though painful sequelae are not seen. Patients who are ambulatory sometimes complain of greater pain on walking than they had experienced after posterior gluteal injections. On the other hand, bedfast patients have had none of the pain previously complained of when lying on their injected buttocks. Our experience is in agreement with the Swiss authors that this technic of intramuscular injecion, if not ideal, is the best available.

**Summary:** 1. The accepted traditional technic of posterior gluteal intramuscular injection is reviewed. The necessity for meticulous care in carrying out the details of that technic is emphasized, if needless pain and morbidity are to be avoided.

2. A questionnaire of nursing practice disclosed remarkable deviation from the details of accurate technic, and revealed a high incidence of needless infliction of pain. Two examples of sciatic neuritis of the author's recent personal experience are cited.

3. A new method of intramuscular injection, proposed by Swiss authors, utilizes the ventral gluteal musculature and is free from hazard of injury to large vessels or nerve trunks. It has proved to be free of morbidity, simple to teach and practice, and almost foolproof of error. It deserves wide adoption.

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# Panel Discussion on Meningomyelocele

*The following abstracts report on talks presented at a panel discussion on the nurses' program during the regional meeting of the American College of Surgeons in Philadelphia, in March, 1961.*

## Only 2,000 of 10,000 Victims Born Each Year Get Attention

The vast majority of patients with meningomyelocele still go untreated. It is estimated that 10,000 babies are born every year with meningomyelocele. Approximately 2,000 receive treatment. At the Children's Hospital in Philadelphia, the operative schedule shows an average of two per week.

In 1951, one could expect that 95 of 100 patients with meningomyelocele would be dead within five years, and 70 percent within three years—all because of calculated neglect. A decade ago, it was assumed that a child would be permanently crippled; that anomalies of the urinary tract were beyond correction; that bladder dysfunction was inevitable; that hydrocephalus was untreatable. Study and research have changed this picture radically. Early death is rare, and 85 percent of youngsters become ambulatory. —*Eugene Spitz, M.D.*, associate professor of pediatric neurosurgery, University of Pennsylvania School of Medicine, Philadelphia.

## Management of Urological Problems: Patients Fall into Two Groups

Patients with meningomyelocele can be divided into two general groups with regard to their urological problems. In children in the first group, the bladder does not act as a reservoir, and urine dribbles out as it is formed by the kidneys. There is never any residual and no problem of infection. After age 5, however, the child is a social problem because of the odor and embarrassment of leakage.

In children in the second group, the bladder is constantly full. Urine dribbles over when capacity is reached, but the bladder is never emptied. There is always a residual, and bacteremia is inevitable. The situation does not become acute before age 1 or 2. After 2, the infection is chronic.

For the child in the first group, nothing is done until he is 4 or 5 years old. Then effort is made to keep him dry, so that he can go to school. The bladder is made to act as a reservoir by compressing the urethra. This is easily done in males with a tight perineal strap that compresses the penis against the

symphysis pubis so that leakage cannot occur. In a fat boy, the technic is less effective.

The mother is taught to empty the bladder every two to three hours by easing the penis out of the strap and letting the urine run out. By the time the patient is 6 or 7, he can do this for himself.

The problem is even simpler with girls, although social and emotional ramifications are greater. At about 4 or 5 years, the leakage is controlled by inserting a tampon into the vagina with the end protruding. This compresses the urethra against the symphysis. Every two or three hours, the tampon is pushed back while the bladder empties, then pulled back into position.

The disadvantage of this technic is that with repeated insertion, the hymen is eroded after six months. Considering the medicolegal problems, the hospital insists that both parents sign a permit for the technic, and the permit is attached to the patient's record.

The extent of the emotional problem becomes obvious when one considers that only five percent of mothers will allow the technic before the child is of school age. By the time the child is 10 or 12, she forces the parents to agree.

In the second group, in whom the bladder never contracts and so never empties, the mother and ultimately the child are trained to empty the bladder by force.

The child lies on a table at the height of the mother's knees. A fenestrated foam-rubber pad protects the meningomyelocele from pressure. Using the clenched fist with the back of the hand and the wrist stiff, the mother leans on the child's abdomen beneath the umbilicus and the skin ring above the symphysis pubis. As the child breathes, she pushes in one-half or three-quarters of an inch. The fists are held in place as the child expires, and with the next breath she advances another one-half inch. When the pulsation of the aorta is felt, the fists are directed obliquely back at a 45° angle so that the knuckles are over the symphysis and the bladder empties. A great deal of body weight is needed.

An intelligent mother can learn the technic in three months, and urinary infection usually disappears in six months to a year. The child may never leak urine and may be socially acceptable at all times. By age 8 or 9, he is usually fairly well matured emotionally and is able to understand and perform the maneuver himself.

This maneuver also solves some of the fecal problem, because the child will defecate at the same time he empties his bladder. In the first group of patients, fecal leakage is handled much the same as a colostomy, with an enema given at the same time every day.

Sulfonamides are administered anywhere from five to 15 years to prevent the major deformities

that complicate infections. Antibiotics are given during the acute episodes of pyelonephritis. Chloramphenicol is probably the most effective agent for urinary-tract infection, but it should be stopped as soon as there is any change in white cells, hemoglobin or platelets.—*Alexander J. Michie, M.D.*, associate professor of pediatric urology, University of Pennsylvania School of Medicine, Philadelphia.

## Fecal Contamination, Skin Irritation Among Problems Nurse Guards Against

The child with meningomyelocele is isolated on admission, and a clean technic is used for all treatments. The Isolette is useful, but the warm, humid atmosphere encourages infection already present. When in use and after use, the Isolette must be cleaned scrupulously. The infant is not dressed and bedclothing is omitted. A lamp is used for warmth if necessary.

A plastic apron is sealed over the buttocks below the sac to prevent fecal contamination. If the sac is in the low lumbar region, the apron may have to be sealed over the gluteal fold. Diapers are fitted under the apron, never up over the back. Buttocks, perineum, and apron are kept clean. Postoperatively, the same technic is used.

The thin sac is protected with non-adhering dressings. A constant drip of a solution of debriding agent keeps the dressing wet. The dressing is changed at least every three hours. Irritation from solution contacting skin around the sac must be prevented, and leakage of spinal fluid must be reported immediately.

The infant can be positioned in only a few ways because of the sac, and skin irritation is a serious problem. A minimal use of cream and lotions and frequent changes of linen help to avert the trouble. Sponge-rubber padding distributes pressure points more evenly.

Preoperatively, the infant is fed in bed unless the sac is covered. Postoperatively, he can be held for feeding unless there are wound complications. He is never on his back until the wound is healed. Careful positioning under the direction of the orthopedic surgeon helps to prevent flexion and contracture deformities. Legs and hips are put through as wide a range of position as possible, but always with care to avoid excessive strain.

Mothers are urged to visit as often as possible and to learn to hold, feed and treat the infant. If there is any hesitation in the mother, she should assume some of the infant's care, under the supervision of the nurse, while he is still in the hospital. She should be reminded that the child must be raised in as normal a pattern as possible. Social-service and public-health resources help with problems related to discharge and home care.—*Eloise Auer, R.N.*, neurosurgical nurse, Children's Hospital, Philadelphia.

# U. of Missouri Eye Bank Supplies Donor Tissue

By John A. Buessler, M.D.,* and Garth S. Russell, M.D.#

Because an increasing number of ophthalmologists are being trained in transplantation technics and are practicing not only in major medical centers, but in less urban areas, a readily available supply of donor eye tissue in their own communities is necessary to allow them to function effectively.

To facilitate the development of such a supply, the University of Missouri, with the volunteered sponsorship of the Missouri Lions Club, established facilities for the collection, preservation, and distribution of donor material at its new medical-center teaching hospital in Columbia, Mo. The Lions Eye Tissue Bank of the University of Missouri has now been successfully operational for almost a year.

In addition to being equipped as a tissue-processing center, the bank stands ready to cooperate with any of the many eye banks already in existence, and has inaugurated a program to encourage the establishment of additional eye-banking facilities wherever practicable throughout Missouri.

Because almost all of the eye banks in this country are concerned exclusively with the collection

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and distribution of fresh tissue, the medical justification for the establishment of this eye-tissue bank was to provide a much-needed laboratory and production unit for the preservation of eye tissue in the central United States.

As is well known, the very limited storage time permitted by fresh eye tissue results in a fair amount of it being lost through spoilage and through its inability to be conveniently shipped long distances or to relatively inaccessible communities. Other effects of this limited storage time are the lack of ready availability of fresh tissue for emergency cases and the restriction of its use by qualified ophthalmologists who are not conveniently situated near a medical center or a fresh-tissue eye bank. As a result, most donor eye tissue is presently used for strictly elective operations, and the patient is held on stand-by call for immediate admission to the hospital if and when fresh material becomes available.

This situation is the reverse of what it could become if modified in part. The eye tissue could be in stand-by storage for immediate use if and when a patient should need it for either an emergency or elective procedure. That the present status of tissue preservation methodology and utilization has now made possible the satisfactory achievement of this objective may be more adequately judged by a review of developments in this field.

## I. Historical

A. *Corneal Grafting*:

Although there is some question as to precisely who first envisioned the clinical application of corneal transplantation, Reisinger, in Germany, as early as 1824, proposed the replacement of opaque human corneas with transparent corneas from animals. For this procedure, he coined the word "keratoplasty," a term used today for all types of corneal transplant surgery. Reisinger, however, limited his own surgical attempts in this field to experiments on rabbits, and the results were only partially successful. His ideas were sufficiently revolutionary that they prompted one of his colleagues, Dieffenbach, in 1831, to point them out as the "most audacious fantasies, and it would be the highest reward of surgery if this operation succeeded."

Nevertheless, his reports stimulated the interest of many ophthalmic surgeons so much that the medical faculty of Munich in 1830 offered a prize for work in keratoplasty. This provided the impetus for more experimentation, and Bigger, in 1831, published the first reports of successful corneal grafting between animals of the same species.

There followed much work down through the years, but it was not until 1906 that Zirm of Germany reported the first successful full-thickness corneal graft from one human to another. Although this proved that corneal homografting in humans was

possible, no dependable source of donor tissue was available until Filatov, working at the Odessa Medical Institute in the early 1930's, demonstrated the usability of corneas obtained from cadavers.[1, 2]

B. *Vitreous Transplantation and Implantation*:

The vitreous humor in the eye, like so many other tissues in the body, lacks the ability to replace itself; thus, when vitreous is lost or destroyed through surgery, disease, or accidental trauma, severe consequences may result. The most frequent complication from loss of vitreous is retinal detachment with subsequent loss of vision.

In 1890, Ford first reported on the beneficial effect of the withdrawal of cloudy vitreous and its replacement with aqueous from the anterior chamber. However, the procedure was beset with many problems. Deutschmann in 1909 reported his unsuccessful attempts at implantations of calf and rabbit vitreous into human eyes. In the intervening years until 1930, various ophthalmologists (Komoto, Elschnig, and Zur Nedden), using Ford's technic, attempted vitreous replacement with various substances such as saline, air, aqueous fluid, and cerebral spinal fluid.

The big breakthrough came in 1946, when Norman L. Cutler first reported his successful replacement of cloudy human vitreous with whole fresh vitreous from human donors. In 1957 Shafer reported the use of whole vitreous implants in over 100 eyes without serious reaction or the loss of a single eye. In addition, Shafer noted that in 64 eyes with retinal detachment supplementarily treated with vitreous implantation, there was successful reattachment of the retina in 29 (45 percent) of the cases. Vitreous implants and transplants are now acceptable surgical procedures, limited largely by the shortage of available donor material.[3, 4, 5, 6]

## II. Transplantation Methods

A. *Cornea*:

There are two basic corneal grafting technics being utilized today. The full-thickness or penetrating graft requires removal of the host cornea through to the anterior chamber (Fig. 1). In this procedure, the donor cornea must be fresh, or if processed for preservation must retain the viability of its endothelial cells. Technically, the procedure is a difficult one, and the postoperative course is long and tedious.

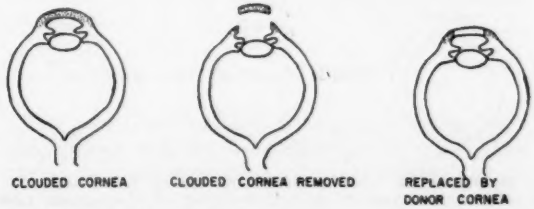


Fig. 1. Penetrating graft.

This type of grafting is used primarily for deep corneal scarring and for mild or moderate keratoconus (conical cornea). Statistically, visual improvement is obtained in approximately 40 percent of cases, with lessened vision resulting in 10 to 20 percent of the cases thus operated upon.

Split-thickness or lamellar grafting involves replacement of only the superficial layers of the cornea. The deeper layers of the cornea and Descemet's membrane are left intact in the host's eye (Fig. 2). Donor corneal material for lamellar grafting has been found not to require viable endothelial cells; hence "processed" or preserved tissue may be used. Fortunately, lamellar corneal transplantation is surgically less difficult than the penetrating type and has a greater number and variety of indications for its use.[7, 8]

B. *Vitreous*:

In patients' eyes in which the crystalline lens is still present, instillation of fresh or reconstituted donor vitreous is most generally accomplished by injecting it into the vitreous chamber by means of a syringe and needle via a small incision through the sclera in the region of the pars plana. When the host eye no longer has its lens, direct instillation may be made into the vitreous chamber via the pupillary space.[6, 9]

Fig. 2. Lamellar graft.

## III. Tissue Preservation

A. *Cornea*:

1. **Refrigerated Storage in Moist Chambers at 4° C.:** The simplest and presently most widely used technic is the storage of the entire eye in a sterile, moist atmosphere at 4° C. The greatest advantage of this technic is its simplicity. This is counterbalanced, however, by the fact that the tissue is usable only up to 72 hours. McPherson and Stocker, by tissue culture in-vitro studies, found that viability was no longer dependable after that length of time. Nevertheless, this method of short-term preservation met the needs of the country fairly well for many years because of the relatively few men qualified to perform corneal transplantation surgery and because of the relatively limited variety of uses then made of donor corneal tissue.[10, 11, 12]

2. **Room Temperature Storage in Glycerol with High-Vacuum Dehydration:** King, here in the United States, has developed a highly successful

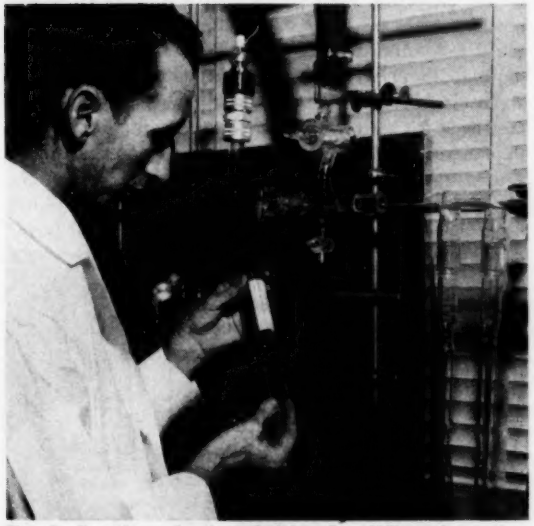

Fig. 3. Eye tissue bank technician Roy Wilson inspects a sealed high-vacuum specimen tube containing a processed human cornea in glycerin.

method of long-term corneal tissue preservation. Of great importance is the fact that storage is effected without refrigeration, thus enabling the material to be stocked at room temperature. The technic involves immersing the donor corneal tissue along with a rim of adjacent sclera in 95% commercial glycerin and subjecting it to high-vacuum dehydration. The specimen-containing tube is then sealed so as to retain the high vacuum and is ready for shipment via the mails and for virtually indefinite non-refrigerated storage[8, 12] (Fig. 3).

*B. Vitreous*:

The problem of long-time preservation of vitreous has been satisfactorily resolved with considerably less difficulty than that encountered with preservation of corneal tissue. The methods currently proffered are refrigerated storage of whole vitreous at 5° C. or—more desirably—room-temperature storage of lyophilized whole vitreous. Vitreous, fortunately, has been found to have the peculiar characteristic of apparent autosterilization, which enables whole vitreous to maintain sterility in sealed tubes at 5° C. storage for long periods of time. Lyophilized vitreous is stored as a dry powder and is reconstituted at the time of use by the addition of sterile distilled water.[6, 9]

## IV. Operation of Missouri Bank

The recent development of long-term donor-tissue preservation and the inauguration of a multi-bank system for fresh eye-tissue collection provide a practical approach to meeting the increasing demand for readily available and usable donor material.

Only through widespread cooperative efforts can donor eyes be obtained in sufficient supply to fill the increasing need for them. In keeping with this principle, the Lions Eye Tissue Bank program of eye-donor recruitment is being conducted with a view to benefitting all banks throughout the state. Its Eye Donor Registration cards have been made to specify that upon death of the registrant the eyes are to be donated to the "nearest eye bank or to the Lions Eye Tissue Bank of the University of Missouri."

Eye enucleation kits, transporting containers (Fig. 4), and permit and record forms are being furnished by the local Lions Clubs to the affiliated fresh eye-tissue collecting banks established as a part of this project. After each use, the enucleation kit is sent to the University of Missouri Medical Center in Columbia, along with the thermos shipping container and completed record forms. A newly packed and sterilized kit (Fig. 5) and a replacement thermos are then returned to the contributing affiliated bank by return carrier.

Fig. 4. Contents of eye enucleation kit with refrigeration thermos used in transporting donor eyes.

Fig. 5. Mrs. Janet Randell, R.N., supervisor of central supply, and Mrs. Marilyn Schelp, R.N., eye operating room, prepare enucleation packs for ethylene-oxide sterilization prior to replacement in kits.

Indicative of the widespread cooperation encountered in this program is the fact that the Missouri State Highway Patrol has volunteered transportation for the fresh donor eyes by relay via its usual patrol routes from any area of the state in which other shipping facilities are inadequate.

At the present time, several recently inaugurated affiliated banks are operational. Together, these banks have already constituted a good source of material for both local utilization and for redistribution. The eyes thus collected have been used as fresh material or have been processed for storage as preserved tissue. Their success has depended in large part upon the interest and generous professional support given them by the local physicians and hospitals throughout Missouri.

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# Formation of Eye-Bank Federation Announced at AAOO Convention

Formation of the Eye-Bank Association of America—a federation of eye banks in all sections of the United States—was announced at the 66th annual meeting of the American Academy of Ophthalmology and Otolaryngology, held in Chicago October 8-13.

Thirty-five eye banks were accepted as charter members of the federation. Named president of the new organization was Ross Guglielmino, president of Associated Eye Banks, Rochester, N. Y. President-elect is L. Byron Holt, M.D., North Carolina Eye Bank, Winston-Salem, N. C.

Purposes of the federation are to coordinate the activities of eye banks, to stimulate the donation of eyes, to establish national legislation on eye donations, and to encourage and finance research in the prevention and treatment of blinding eye diseases.

The announcement of the group's formation stressed the importance of educating the public to make eye donations to local banks, rather than making such donations in wills. If a donation is made in a will, the donor's wish probably will not be known until too late to make use of the eyes, which must be removed within six hours after death if they are to be used for transplanting.

New president of the AAOO is Lawrence R. Boies, M.D., Minneapolis, who succeeded Dohrmann K. Pischel, M.D., San Francisco. Albert D. Ruedemann, M.D., president and director, Kresge Eye Institute, Detroit, was named president-elect.

Following are highlights of selected papers.

## Aid for Diagnosing Eye Ailments

The "sniperscope," an electronic instrument used in World War II to make enemy soldiers visible at night to American sharpshooters, is being adapted for diagnosis of deep-seated eye abnormalities, according to an exhibit presented by the Office of Naval Research.

The apparatus employs infrared rays which are capable of passing through corneas which have been made opaque by injury or disease. It provides continuous direct observation of eye structures back of the cornea, thus permitting surveillance of changes that occur during the administration of drugs or during minor surgical procedures. It also frequently discloses long-standing afflictions such as tumors of the eye or atrophy of the iris, which may have arisen after the surface opacity developed.

The device may help physicians decide whether corneal transplant surgery is advisable. If it detects abnormalities in the deeper eye tissue, physicians may conclude that these defects lessen the possibility for sight restoration.

## Sterilization of Tonometers

A thorough study of the technics for sterilizing tonometers—including an evaluation of the effectiveness, simplicity, durability, time consumption, cost, and damage to the tonometers by the technics—showed that no method previously described satisfactorily met all of these requirements, said Ronald M. Wood, Ph.D., Baltimore.

A thin, sterile, disposable membrane was developed to enclose the footplate, plunger, and barrel of the tonometer. Laboratory and clinical findings show that the membrane does not alter tonometer accuracy, Dr. Wood said. It acts as a physical barrier between the tonometer and the eye to prevent infection.

## Tympanoplasty

Since the advent of the various tympanoplasty procedures, perhaps too much emphasis has been placed upon the improvement of hearing with these procedures rather than on the control of the disease, Woodrow D. Schlosser, M.D., Philadelphia, declared in a symposium on tympanoplasty. The aims of tympanoplastic surgery, he emphasized, must be the same as those of the older mastoid procedures: to control the disease first and then to seek to improve the hearing sensitivity.

It now is held, he said, that extensive mastoid surgery involving various skin-grafting procedures combined with muscle-graft implants to obliterate the mastoid bowl gives promise of providing the best single answer to the twofold purpose of tympanoplasty.

Contraindications to tympanoplasty, according to Seymour J. Brockman, M.D., Los Angeles, are: diffuse

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cholesteatosis—primarily pediatric, occasionally adult; tympanosclerosis—osteoclastic form; fixed stapes; atrophic mucosa of the middle ear; local manifestation of systemic illness, such as tuberculosis; nonfunctioning or poor-functioning eustachian tube; acute infection of temporal bone; persistent upper-respiratory manifestations, such as allergy, sinusitis, endocrinopathy, infections, and septal deviations; significant sensorineural defects; and nonfunctioning round window.

## Granuloma After Scleral Buckling

A series of cases of chronic granuloma of the eye which followed encircling scleral buckling operations for retinal detachment was described by William G. Everett, M.D., Dorothy C. Scott, M.D., and Margaret C. Sharrer, M.D., of Pittsburgh. The granulomas were observed following the use of polyethylene tubing and silicone rubber tubing with intraluminal silk sutures.

Granulomas of this type appear at the open ends of the tube, the speakers said, at any time from a few weeks to many months after surgery. In one case in which an encircling solid silicone rod was used with two polyethylene cuffs and no intraluminal suture, typical granulomas developed at the ends of the polyethylene cuffs.

Granulomas have not been observed in segmental scleral buckling operations when only a section of

tubing of either polyethylene or silicone was buried in the sclera.

These lesions have uniformly failed to respond to topical or systemic treatment. Removal of the tube and suture, or of the silk suture alone, will relieve the granulomas.

Experiments in dogs showed that polyethylene and silicone tubes without intraluminal sutures and solid silicone rods did not produce granulomas. The results of these studies led to the development of a new solid silicone rod with an incorporated Mersilene suture for scleral buckling in retinal detachment surgery. Clinical use of this material for one and one-half years has resulted in no granulomas.

## Toxicity from Local Anesthetics

Local anesthetics should not be given routinely, because although they are ordinarily harmless, they can cause a reaction, even a heart-stoppage, in some persons, according to John S. Lundy, M.D., VA Research Hospital, Chicago.

Before giving a local anesthetic, Dr. Lundy pointed out, the physician should take a history of the patient's sensitivities, especially from prior experiences, and should examine him for the condition of mind and body. Among the factors to be considered is the patient's disposition. Preoperative preparation should include mental preparation—the use of suggestion and assurance; medication, for mood and prophylaxis against untoward effects of the local anesthetic; and measures to lower fever, if it is present. There should be support for special postures and procedures: mechanical support, vasopressure, blood loss, and devices to aid body comfort, such as air conditioning and electric fans.

Redheads, Dr. Lundy noted, are more sensitive to pain than blondes or brunettes.

## Effect of Vasodilator Drugs

Many ophthalmologists administer drugs that are peripheral vasodilators in an attempt to increase the volume of blood in the eye, but actually effective peripheral dilators diminish the intraocular blood volume, said Irving J. Leopold, M.D., Philadelphia, who for several years has been studying effects of these drugs in experimental animals. Certain peripheral vasodilators—for example, nicotinic acid—produced little or no effect, he found.

Effective vasoconstrictors, such as epinephrine and levarterenol, caused a marked increase in the intraocular blood volume.

Dr. Leopold suggested that the use of peripheral vasodilators is contraindicated for intraocular conditions that seem to be associated with diminished blood supply.

# Cardiac Surgery in a 224-Bed Community Hospital

By Sister Mary Alvera Simon, R.S.M.; Ramona Pike, R.N.; Mary Spencer, R.N.; Ivan Thiessen, Bobby Singleton, and Modine Pierce*

The system and technic as evolved by Zuhdi, Carey and Greer [1, 2] (Diagram 1) have rendered open-heart surgery within the realm of any community hospital that deals with major surgery.

Mercy Hospital in Oklahoma City is a 222-bed privately owned nonprofit general hospital, which has been doing open-heart surgery since January, 1959, following numerous experimental procedures on animals in its Heart and Research Institute.[1] This type of surgery is scheduled in our institution as any other type of operative procedure, and the preparation needed does not exceed that for cholecystectomy, for instance.

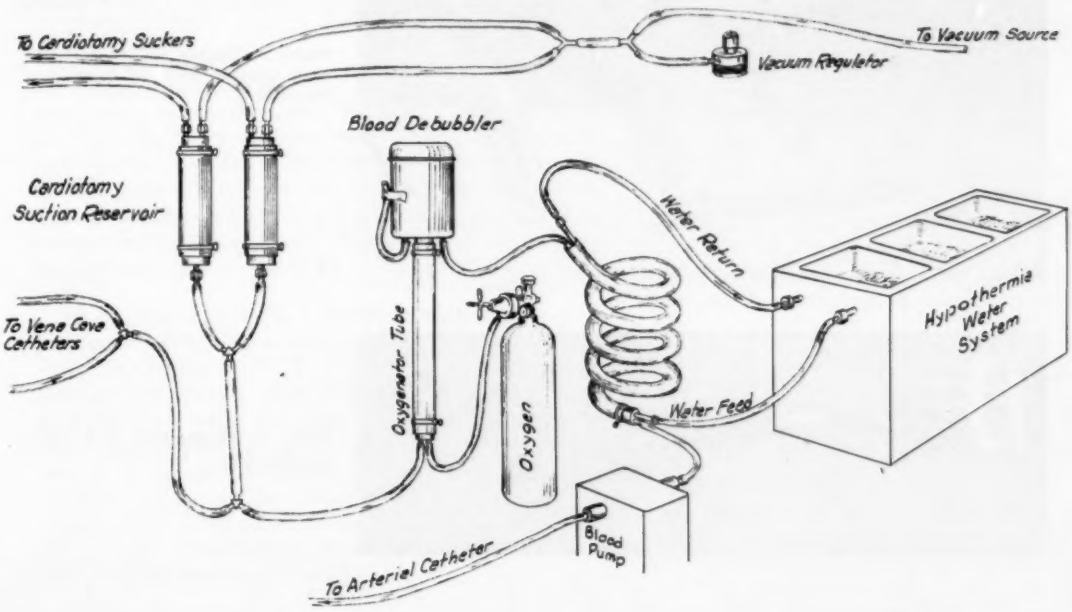
The authors prepared this article in the belief that others who are doing or are planning to do open-heart surgery may benefit from the nurses' experience and from learning their method of preparing for this type of operation.

## I. Preparation of the Heart-Lung Machine

For the cardiopulmonary bypass, we use a modified DeWall-Lillehei heart-lung machine, with a volume-decreasing heat-exchanger[2, 3, 4]. This heat

*Sister Mary Alvera is operating-room supervisor, Mercy Hospital, Oklahoma City, Okla., and Miss Pike and Miss Spencer are on the operating-room nursing staff. Mr. Thiessen is a surgical technician; Mr. Singleton, a laboratory assistant; and Miss Pierce, a research assistant.

Diagram 1. (Below) The system as evolved and used at Mercy Hospital, Oklahoma City, Okla.



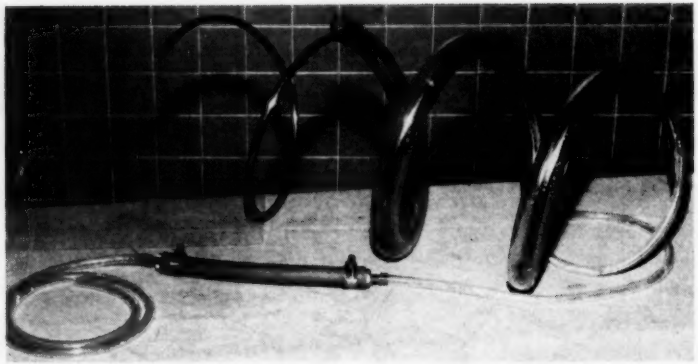


Photo 1. Double helical reservoir and arterial limb of heart-lung machine.

Photo 2. Oxygenator and canister debubbler.

exchange is accomplished by means of a stainless steel coil which is inserted into and extends beyond both ends of the mayon helix and through which warm or cold water is countercurrently circulated[5]**.

*A. The Mayon Tubing*

All tubing is washed carefully in a solution of green soap and water, and thoroughly rinsed for five minutes by running water under pressure through each piece (see lists in Figs. 1 and 2). The long tubing is wound into a loose coil without overlap or kink, and the loose ends are secured with autoclave tape. The tubing is examined for areas of weakness or apparent defects.

The tubing is placed in a double wrapper and autoclaved, without placing anything heavy on it, for 30 minutes at 250°. F., under 20 pounds of pressure. To insure transparency, autoclaving should be done seven to 10 days prior to surgery. An alternate technic to insure transparency consists of drying the tubing for two hours, opening the door, and leaving the tubing in the autoclave until it is cool. Opacity of the tubing renders difficult the visualization of air bubbles and degree of oxygenation.

**A Kimray triple-temperature water circulating system is used.

*B. The Double Helix* (photograph 1)

The double helix serves as a reservoir, bubble separator and heat-exchanger[6], and is assembled by threading the metal coil inside the mayon tubing after moistening both. The open ends of the tubing are covered with gauze sponges and secured with autoclave tape. The entire helix is wrapped and autoclaved as above.

*C. The Oxygenator* (photograph 2)

The oxygenator consists of these pieces:

1. A 25″ piece of 1½″ mayon tubing for mixing the oxygen and blood when the large canister is used and a 1″ tubing for the smaller one.
2. An oxygen bubbler fitting
3. A 52″ piece of ¼″ tubing to the oxygen source.

*D. The Debubbler* (photographs 1 and 2)

1. The canister, a three-quart stainless steel dressing can with three openings in the bottom, is used for patients weighing more than 50 kg. and a two-quart can for patients weighing less than 50 kg.
2. A nylon filter.†
3. Two 12″ pieces of ⅜″ tubing, one for the outflow into the helix and one for level detection.

†Phelan Manufacturing Co., Minneapolis, Minn.

## Figures 1-9

**Fig. 1. Tubing for a patient weighing more than 50 kg.**

| *No. of pieces* | *Type* | *Size* | *Length* | *Purpose* |
|---|---|---|---|---|
| 7 | Mayon | ⅜" I.D. | 52" | To carry blood |
| 1 | " | ¼" I.D. | 52" | For oxygen |
| 2 | " | 2½" I.D. | 8" | Cardiotomy suction |
| 1 | " | 1½" I.D. | 24" | Oxygen mixing tube |
| 1 | " | 1¼" I.D. | 82" | Helix |
| 1 | Latex rubber | ¾" I.D. | 12" | Pump head |

**Fig. 2. Tubing for a patient weighing less than 50 kg.**

| *No. of pieces* | *Type* | *Size* | *Length* | *Purpose* |
|---|---|---|---|---|
| 4 | Mayon | ⅜" I.D. | 52" | To carry blood |
| 3 | " | ¼" I.D. | 52" | To carry blood |
| 1 | " | 2½" I.D. | 8" | Cardiotomy suction |
| 1 | " | 1" I.D. | 24" | Oxygen mixing |
| 1 | " | 1" I.D. | 82" | Helix |
| 1 | Latex rubber | ½" I.D. | 12" | Pump head |

**Fig. 3. Stainless steel connectors**

2⅜" x ¾" connectors (2¼" x ½" for child)
4⅜" x ⅜" straight connectors
2⅜" x ¼" straight connectors
3⅜" x ⅜" straight connectors
3⅜" x ⅜" x ⅜" Y-connectors (2⅜" x ¼" x ¼" for child)

**Fig. 4. Stoppers**

2 3" with one ⅜" tube entrance
2 3" with one ⅜" and one ¼" tube entrance
1 1" with one ⅜" and one ¼" tube entrance
1 1¼" with one ⅜" and one ¼" tube entrance

**Fig. 5. Pack for assembling the heart-lung machine**

Large splash basin
Towels (5)
Mayo table drape
Screwdriver
Rubber bands (24)
Connectors (required sizes and number)
Hosebands (required number)
Gown
Glove powder

**Fig. 6. Linen pack #1**

Gowns (5)
Towels (24)

**Fig. 7. Linen pack #2**

Combination instrument table and patient drape
Second cover for instrument table. Suture is placed under this drape
Radiopaque sponges, 4x4's (12)
Abdominal packs (24)

**Fig. 8. Pack of small items**

50-cc. syringes (2)
An assortment of different sizes of syringes
Medicine glasses (3)

Umbilical tape, 24" lengths (6)
Catheter, 14 French (cut in two 6" lengths)
Suture needles (assorted)
Peanut dissectors (2)
Stockinette 2" wide for retractor boots
Suction tubing, 36" lengths (2)
Stainless steel wire (20-24-26)

**Fig. 9. Necessary equipment in the operating room**
Instrument table
Intravenous poles (3)
Portable suction machine
Wall suction units (2)
Scales for weighing sponges
Cardioscope or electronics for medicine
Defibrillator and electrodes
Portable spotlight
Special drugs
Venesection tray

4. Two steel mesh sponges.

The canister is assembled before the day of surgery. The can and all its parts are cleaned with ether to remove the silicone, washed with green soap and 1% solution of sodium hydroxide, and rinsed with running water. The inside of the can and all its parts are sprayed with a thin film of silicone; the filter is slipped in place over the central post, followed by a disc, two steel mesh sponges, and another disc. Then the filter is drawn together at the top. The lid of the canister is then taped in place, wrapped, and autoclaved.

*E. Connectors, Stoppers and Hosebands* (Figs. 3,4)
These are washed in green soap and water, followed by a solution of 1% sodium hydroxide, and rinsed thoroughly. In washing the connectors, care must be taken that the inner surfaces are not scratched or damaged. Only a soft cloth should be used—not a brush.

*F. Packs*
1. A pack is prepared for the nurse assembling the machine (Fig. 5).
2. Two linen packs are prepared for the scrub nurse (Figs. 6 and 7).

*G. Immediate Preparation of the Machine*
About 30 minutes prior to surgery, the heart-lung machine is assembled in the following order:
1. The helix
2. The arterial line
3. The oxygenator tube and the canister
4. The cardiotomy suction reservoir[7] (photograph 3)
5. The vacuum regulator to the reservoir and to the vacuum source[7]
6. The stainless steel coil to the heat source

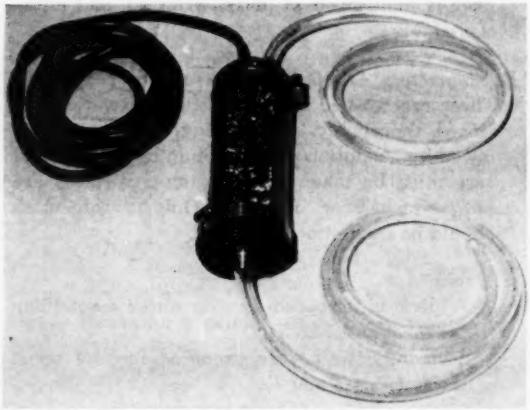


Photo 3. Cardiotomy suction.

7. The oxygenator to the oxygen source.

After the helix and arterial line are ready, these are given to the nurse's assistant, who fills the helix with warm saline, and checks the helix and arterial line carefully to see that all air bubbles are eliminated. The latex tubing of the arterial line is now placed in the Sigmamotor pump head, and the pump is checked to make sure it is properly occlusive. The arterial flow rate is calibrated at 20 cc. per minute per kilogram of body weight, using a graduated beaker.

After calibration, the helix is emptied of saline to within approximately four inches of the bottom stopper and filled with the desired amount of 5% dextrose in water. The remaining saline used for priming is removed from the system by pumping it out and replacing it with 5% dextrose in water. The priming volume is calculated using the formula, kilogram weight X 16 cc.[2] The machine is now ready for use.

**II. Preparation of the Operating Room, Linen and Other Supplies**

The preparation of the operating room and the supplies and equipment to be used are the responsibility of both the circulating nurse and the scrub nurse. The scrub nurse prepares a special pack prior to surgery that contains all the necessary small items (Fig. 8). These are placed in a basin to be sterilized. This conserves time in "setting up."

A combination drape, 11′ x 6′, drapes both patient and instrument table. This drape has a horizontal opening for the chest incision and a vertical opening for the femoral cannulation. The femoral opening has a flap that may be used to cover the femoral incision if desired. The compact instrument table[8] (see photograph 4) is used in all open-heart surgery procedures. Prior to surgery, the operating room must be checked for all necessary equipment (Fig. 9).

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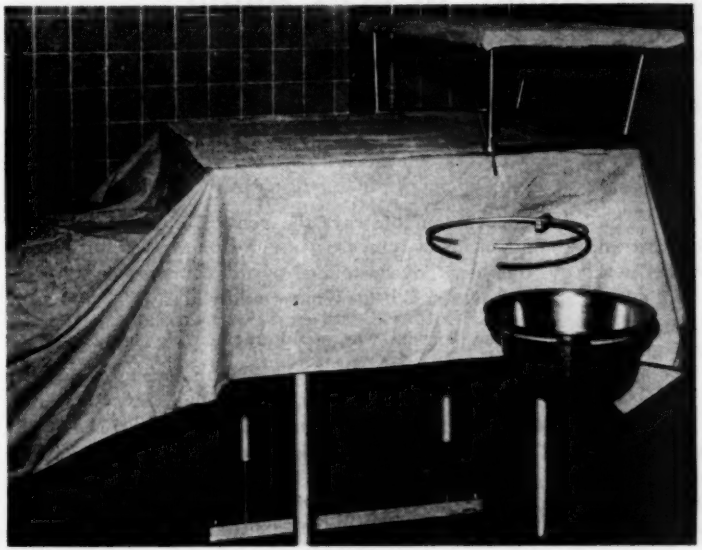


Photo 4. Double-deck table for surgery.

# Hearts 'Too Good to Die' Are Given Dramatic Second Chance to Beat Again

By Ellen L. Davis

Claude S. Beck, M.D., one of America's most eminent pioneers in heart surgery, leaned forward and picked up a plastic model of a heart from his desk. Most of it was a healthy-looking pink, but in the lower center there was an area of ominous blue.

"Visualize this as a human heart, belonging to someone very important to you," he said. "It's been a good heart, pumping away efficiently year after year. It's still a good heart—remember, now, it's *still* a good heart—but it's in very grave danger.

"When blue muscle is in contact with pink muscle, dangerous electrical currents are set up that can electrocute the heart; that is, put the heart into convulsion that destroys the beat. This is a fatal heart attack. Now suppose your doctor arrived just when this heart, overwhelmed by the catastrophic disaster, had ceased to beat. What would you say?"

The answer was spontaneous. "*Do* something."

Dr. Beck spent several moments gazing out of the window of the Lakeside Hospital, in Cleveland, which has been his base of operations for over 25 years, then swung back and said quietly, "Exactly."

"About 30 years ago," he continued, "when I was doing almost all of the heart surgery being performed in this country, a little 14-year-old patient

died on the table when her heart went into convulsion. It was a good heart, a young heart, with plenty of life in it. It was too good to die. I kept saying to myself, over and over, 'do something.' But I didn't know what to do, so I just stood there in a cold sweat."

On June 16, 1947, the heart of another adolescent, a boy, went into convulsion. This time, Dr. Beck knew what to do, and he performed the first successful defibrillation in the history of medicine. A strong electric shock applied to the surface of the heart had stopped the convulsion produced by the electric shock it had already dealt itself internally.

In June, 1955, a Cleveland doctor, Albert Ransone, was on his way out of the Lakeside Hospital when he fell over dead in the lobby. One of Dr. Beck's former students, Eldon Weckesser, M.D., pumped the heart by hand, Dr. Beck shocked the heart out of fibrillation, and the team marked its first reversal of death itself.

The years between the first time Dr. Beck stood helpless before a death he felt didn't have to happen, the day he first prevented it, and the day his knowledge literally forced death to give back a life it had stolen were arduous ones.

His interest in the field of cardiac surgery began in 1924. A year later he started his long association with Lakeside Hospital, where he devoted his attention to diseases of the sac around the heart. He noted that the laboratory was showing a loss of dogs due to heart convulsion. Up to that time they had simply been disposed of—and with them often went weeks and months of experiment. Dr. Beck had a dual purpose in trying to salvage these dogs. He wanted to know more about the heart, and he wanted to recoup the laboratory losses. His early studies resulted in the description and clarification of the thick scars on the heart from prior damage, which squeeze the organ. His next step was the removal of scars, a very rare procedure in 1930.

"I was removing a scar—they peeled off like an orange rind—when the heart suddenly fibrillated," said Dr. Beck. "The challenge then was to throw the heart out of convulsion, and this marked the beginning of the interest that has occupied my attention throughout the intervening years.

"There were plenty of clues to help me," he went on, "But some were very obscure, and others had been buried and forgotten. In 1889, two French investigators, Batelli and Prevost, successfully brought dogs' hearts out of ventricular fibrillation by application of strong alternating electric currents. Their work attracted very little attention, and it became lost entirely until its rediscovery some 25 or 30 years later by Hooker, of Johns Hopkins, and Wiggers, of this hospital.

"Crile and Dolley published their laboratory work on the resuscitation of dogs in 1906. They found no

difficulty in reviving the asphyxiated heart with perfusion or massage. About 50 years ago Crile observed, 'In regard to resuscitation of the body as a whole, the fact has not been sufficiently appreciated that the greatest and most essential difficulty is to overcome the anemia of the brain rather than the heart.

"This was a most astute observation, too long overlooked, and still not given proper significance in all quarters. The deadline for the brain to be without oxygen is three to five minutes. Resumption of the heartbeat is secondary.

"So I knew, in those early days," continued Dr. Beck, "that if one touches the heart with a little wire, the slight electric shock will produce a convulsion. I learned that if electrodes and heavier current were applied, it makes all the muscles contract at the same time and stop at the same time. It puts the rhythm back into the organ."

Kirstan Igelsrude, of Norway, did the first successful resuscitation of the heart from standstill, or asystole, in 1903. While still a very young man, Dr. Beck made a picture presentation of how this procedure was done on a dog's heart, but it stimulated no discussion in the professional group to whom it was shown. In 1937, he made a film on the procedure and presented it before the American Surgical Association. "It was to them," he recalled, "a laboratory curiosity only.

"I tried the defibrillation method on humans without success over a long period of time. "Maybe I waited too long before starting the resuscitation; maybe I didn't do it right. I don't know the cause of the failure, but I did know it could be done."

Dr. Beck's first successful defibrillation in 1947 of the young boy, mentioned previously, required 75 minutes of cardiac massage and a series of electrical shocks to return the heart to a coordinated beat. After considerable experimentation, Beck and H. J. Rand, his collaborator in much of the work, developed a practical suction-cup electrode defibrillator. Today, a number of manufacturers have defibrillation machines on the market, and recoveries are now commonplace in many of our leading hospitals.

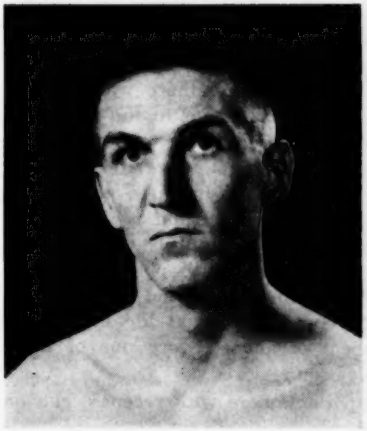
In 1950, Beck, his associate, David S. Leighninger, M.D., and Robert M. Hosler, M.D., with the sponsorship of the Cleveland Area Heart Society, inaugurated what is thought to be the first course of its kind, and the first concerted attempt by the medical profession to establish a practical education program for the prevention and treatment of cardiac arrest.

In an article in *The American Journal of Cardiology,* Dr. Hosler commented, "Why this queer lack of knowledge (on resuscitation) prevailed in medical educational circles is difficult to explain. This subject from 1902 to 1950 seemed to be in an underground tunnel of despair, and then it suddenly emerged into the light of practicality."

To date, some 2,000 surgeons, anesthetists, dentists and nurses have participated in the course. They have come from the four corners of the United States and from many foreign countries. It seems fitting that one of the students of the man who traveled that "tunnel of despair" should have been on the scene the day Dr. Ransone dropped dead in the lobby of the Lakeside Hospital.

He had just had an EKG at the hospital and was on his way out to go to his own physician's office when he was felled. Dr. Weckesser opened his chest immediately, pumped the heart by hand, got oxygen into the lungs. Dr. Beck then shocked the heart out of fibrillation. Dr. Ransone made a complete recovery, and returned to full practice. He has since retired, and is living in Florida.

"From Dr. Ransone's experience," said Dr. Beck, "we learned, or had forcefully re-presented to us, three enormously important facts. First, that death often occurs in a heart too good to die. Second, the factor that kills is often small—like stopping the pendulum of a clock. The fact that the pendulum is



Left, Richard Heyard, the first human to be defibrillated successfully. In June, 1947, his heart went into convulsion. Dr. Beck restored a coordinated beat after 75 minutes of cardiac massage and a series of electrical shocks. The picture of Mr. Heyward was taken several months ago.

Right, Albert Ransone, M.D., dropped dead in the lobby of Lakeside Hospital in June, 1955. His death was reversed by Dr. Beck and a former student, Eldon Weckesser, M.D. Dr. Ransone returned to full practice, later retired to Florida, where this recent picture was taken.

stopped does not mean that the clock will no longer run. It needs only the touch of a fingertip to start the pendulum to swinging and the clock to ticking again. And third, the fatal heart attack is not necessarily the end of life, depending on what is done at the moment of death. A good heart needs only a second chance to beat again.

"This second chance is as revolutionary as was William Harvey's discovery of the circulation of the blood 300 years ago. Now that we know about the blood's circulation, we can't understand why it took us so long to discover it. And now that we know about heart resuscitation, we can't understand why it took us until the middle of the twentieth century to discover it—especially since we had some clues.

"I mentioned some of the clues available when I first became interested in resuscitation. We had some more, which I can understand and explain quite well —now that I've spent the major part of my life following them up and figuring them out!

"For instance, we have a nice, pink heart, and all is going along very well with it. Then a cholesterol slug is deposited in one of the coronary arteries that feed blood into the heart. As this pass narrows, a portion of the muscle doesn't get enough blood and turns blue. Next to the blue muscle is pink muscle. Electricity is produced at the border between the two.

"The medical profession knew for a long time that electricity could be produced by the heart when an artery was blocked off. But doctors thought this electricity was produced by injury to the muscle. We have shown that it is produced, without injury, by the reduced inflow of red blood.

"The heart which is blue all over, as in a blue baby, is a safe heart; it does not electrocute the owner. A patient with lung disease has a blue heart, even his lips are blue, but he has a safe, all-one-color heart. There is no anginal pain, there is no heart attack. But the nice, pink heart with a blue spot in it is painful, and it is a killer, often in the bloom of life.

"Drs. Lester Adelson and William Hoffman, of the coroner's office here in Cleveland," continued Dr. Beck, "analyzed 500 victims of sudden, fatal heart attack. They found that in six or seven of every 10 victims brought into the office, there was no new disease in the coronary arteries or in the muscle to account for death. They were coronary artery people, *but there was nothing new added to their condition sufficient to kill them.* In these people, the stopped heart of today was the same as the beating heart of yesterday, except that this death factor, electricity, came, and killed, and disappeared. No evidence of its visitation could be found in the heart. If we had been prepared to act at the moment of death, the heartbeat of almost every one of these victims could have been restored.

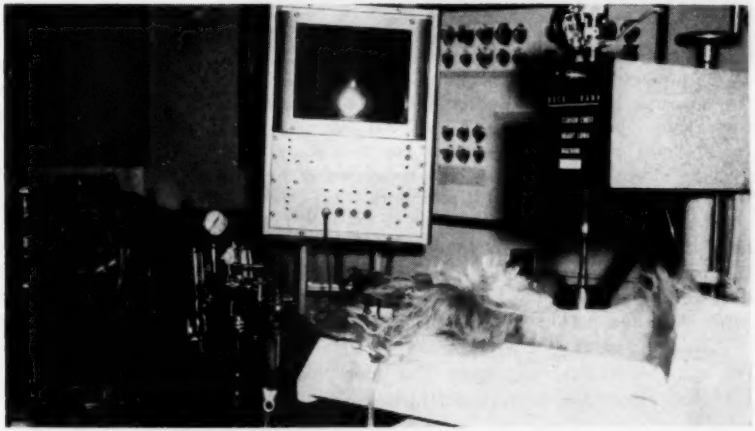
"We have had patients here with recent occlusion

producing enough new damage to hospitalize them. In spite of this, we have reversed death in 10 such victims, and eight of them are alive months and years later."

Since they have proven that death can be reversed, Drs. Beck and Leighninger have been concentrating considerable attention on prevention of electrical shock in susceptible hearts.

According to the two specialists, the significance of the oxygen differentials in such hearts is out of all proportion to the structural change in a coronary artery that produces them. Reduction of differentials is brought about by moving blood from the pink, well-oxygenated muscle, to the blue, poorly-oxygenated muscle. This transfer is brought about by opening up small non-functional channels that already exist, and by the creation of new intercoronary arterial channels. This is accomplished momentarily by the vasodilating drugs, and permanently by the Beck operation, a simply done, surface operation on the heart.

"You will recall," went on Dr. Beck, "that I mentioned Crile's astute remark about the importance of overcoming anemia of the brain in resuscitation. It is



Laboratory dog has been anesthetized with the Heidbrink anesthesia equipment shown on the left, and the heart fibrillated by electric shock. The Beck-Rand Closed-Chest Heart-lung machine has kept the brain alive by pumping the closed chest for over an hour.

Dr. Beck points to the tube that carries air or oxygen from the respirator portion of the Beck-Rand machine to the intratracheal tube of the dog. During this interview, the famed heart pioneer stressed that the first concern is getting oxygen into the lungs and circulating it to the brain. Restoring the heartbeat is secondary.

of first importance, and so you will understand that the fundamental technic of cardiac resuscitation is, one, get oxygen into the lungs and circulate it to the brain; and two, restore the heartbeat.

"The brain cannot be without oxygen for more than five minutes at the very most. The good heart, like the good clock, can be restored to ticking at a later moment. If the patient is dead longer than five to eight minutes, we do not even attempt resuscitation, because the human being would become a 'vegetable.' Fortunately for our peace of mind, however, if the brain is gone, the victim usually dies anyhow."

The resuscitation procedure is divided into two parts. Both are essential; one without the other is no good. Reduced to bare outline, part one consists of getting oxygen into the lungs and circulating it to the brain.

The best method involves the use of an intratracheal tube and a rubber bag of oxygen which is squeezed by hand. The next best method is the use of an airway in the mouth, a face mask over the mouth, and a bag of oxygen which is squeezed by hand. Next in order are mouth-to-mouth-double-airway breathing methods. If the trachea is obstructed and cannot be cleared, tracheotomy is done.

The second part of the procedure is the opening of the chest for hand pumping of the heart, which is begun immediately. There are several methods of doing this, but general rules apply to all of them: both ventricles are to be emptied; the grip on the heart is purposely relaxed to allow filling (there is no pressure behind the venous flow); an empty heart is not squeezed; and the heart can be bruised or a finger stuck into one of the cavities by excessive force. The rate of pumping varies from 60 to 80 a minute. An

arterial pressure of 80 to 100 mm. Hg. can be produced by good pumping.

"To try to reverse death by opening the chest and pumping the heart," observed Dr. Beck, "is a magnificent but unpleasant task of resuscitation. The procedure, up to now, has been more or less limited to hospital operating and emergency rooms or other adequately equipped areas, though the technic itself does not require formal medical training, as our resuscitation courses have proven.

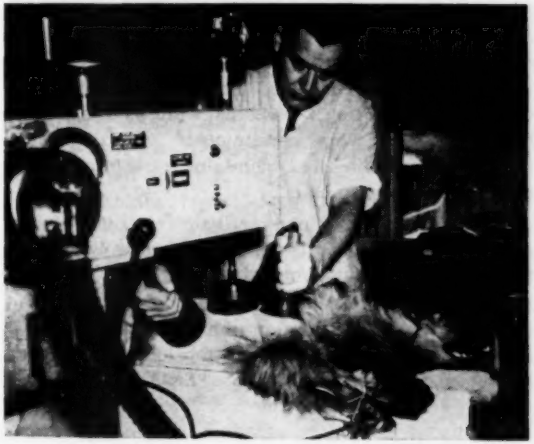
"Our goal now is to make the procedure mobile—to get it to the man or woman who drops dead on the course after a game of golf, or on the sidewalk after shoveling snow. The closed-chest method of resuscitation, developed at Johns Hopkins just a few months ago, has given us added impetus. It's a good technic, but it's strenuous for a lone operator to maintain anything like consistent, regular resuscitation against the chest all over a long period of time.

"We are now hopeful we have found the solution. Working with H. J. Rand, we have developed a closed heart-lung machine, which both administers oxygen and mechanically pumps the heart."

Dr. Beck glanced at the clock. "An hour ago," he said, "Dr. Leighninger electrocuted one of our laboratory dogs. The new machine, which we're using for the first time,* has been keeping the dog alive by pumping the fibrillating heart and moving oxygenated blood to the brain. In 10 minutes he will attempt to reverse the death with an external defibrillator. Shall we go watch?"

*This experiment was conducted March 8.

Below, Dr. Leighninger puts in place the electrodes which shortly shocked the dog's heart out of fibrillation and restored him to life, and a complete recovery. In the background is the Rand defibrillator, which was used to shock the heart into convulsion. It cannot be used for defibrillation with the closed-chest method because it does not carry sufficient voltage.



When we arrived, the Beck-Rand closed heart-lung machine was pumping the closed chest, squeezing the heart between the sternum and spine at a rate of 60 times a minute, moving the sternum up and down about one-and-a-half inches. The dog's paws were cold to our touch, his lolling tongue was partially blue.

An intratracheal tube in the dog's trachea was connected to the breathing device of the machine so that every other time the plunger came off the chest, about 500 to 700 cc. of room air was delivered to its lungs.

Dr. Leighninger had injected two cubic centimeters of epinephrine solution (stock adrenalin, 1:1,000 concentration) subcutaneously over the sternum so that the plunger massaged the adrenalin into the circulation. The dog's EKG as well as the aortic blood pressure were continuously recorded. The Beck-Rand machine had maintained a normal blood pressure for over an hour.

Ten minutes after our arrival, Dr. Leighninger defibrillated the heart by passing a current of electricity of 440 volts through the intact chest for one-quarter second.

Shocked out of fibrillation, the heart started beating again. Simultaneously, the tension in the room broke as the heartbeat on the EKG strengthened and steadied, and two specialists, two laboratory assistants and one visitor breathed normally again.

The machine was turned off as soon as the heart was defibrillated. The dog was disconnected from the monitoring devices and was breathing on his own.

"We anticipate," said Dr. Beck, "that a modification of the machine will be placed in all rescue trucks, in doctors' office buildings, perhaps in large office buildings, in baseball parks and other areas where crowds congregate. It will be portable so that the victims can be transported to the hospital where the heart beat can be restored by closed or open technic, whichever is necessary.

"It is realized, of course, that not every death can be successfully reversed. To fail, of course, is to invite criticism. To do nothing, like the high priest, is to be perfect."

Taking his leave to say goodbye to a South American physician who was leaving for home following his recovery from cardiac surgery, Dr. Beck extended his hand. The strong, sure hand of a man who all his adult life wanted only to "do something" for hearts to good to die, and in doing it, dealth death its most stunning defeat, and gave life another chance.

The dog on the table was stirring slightly as we left the laboratory. We touched him in passing. His paws were warm, his tongue was a nice, healthy, all-one-color pink.

# Nurses' Sessions Probe Arterial Grafts, Open-Heart Surgery

*Approximately 1,500 graduate nurses attended the nurses' programs held during the sectional meeting of the American College of Surgeons in Philadelphia March 6-9.* TOPICS' *nurse consultant, Dorothy W. Errera, was on the scene. Following is the first part of her report. For other material; see pages 56 and 80.*

## *Arterial Grafts*

### Arteriography Essential in Work-up; Lists Hazards to Patient

Arteriography is an essential part of work-up of the patient to determine the extent of disease and the presence or absence of collateral channels. There are hazards involved. The dye can produce a toxic reaction. If the dye is too highly concentrated, there may be a loss of function (kidney function, for instance) or there may be a transverse myelitis. There is always the chance of introducing the needle into an aneurysm, which would cause leakage and rupture, or of displacing an atherosclerotic plaque.

Arteriography is not done for aneurysms unless they are higher than the renal vessels.

Homografts were among the first prostheses used. They are foreign bodies and react as such. An atheroma will destroy the wall of a homograft. Knitted prostheses are preferable, because they last longer and the fibrous tissue formed gives them good body.

The complications of arterial surgery are those of any major surgery. Hemorrhage either on the table or postoperatively is always possible. Drains are not

used because of the increased likelihood of infection. Thrombosis is apt to occur early but becomes less likely as time passes unless obstruction occurs. Visceral damage is possible because of occlusion of the circulation. There is also the possibility of visceral embolus or clot formation which can cause trouble for the patient in the future.—*R. Robert Tyson, M.D.*, associate professor of surgery, Temple University School of Medicine, Philadelphia.

## Setup for Arterial Surgery Described; Knitted Grafts Called Superior

Anticoagulants, umbilical tape, fine arterial silk sutures, and a graft are included in the setup for arterial surgery. If a sterile homograft is used, it is reconstituted in the container with a drip of sterile normal saline. When it is removed, the small vessels are ligated with fine black silk.

Knitted grafts of dacron, nylon and Teflon are superior to previous forms. They are elastic, do not allow blood seepage, can be cut at any angle without fraying, and can be resterilized in steam several times without deterioration. They are now available as seamless tubes in various sizes and as bifurcating or multi-branched tubes.

Accurate recording of blood loss is imperative in this type of surgery.—*Mildred Guzara, R.N.*, operating-room supervisor, Temple University Hospital, Philadelphia.

## Postoperative Care Outlined; Patient Needs Nurse's Reassurance

Aortography will establish the diagnosis of aortic aneurysm and is done early in the course of the treatment. The diseased segment of the aorta is resected, and an arterial graft—either a plastic prosthesis or a homograft—is inserted. The graft serves as a framework for the build-up of new endothelial lining and fibrous tissue wall.

If the aneurysm is located anywhere below the renal arteries, it is possible to maintain complete occlusion of the aorta without hypothermia or temporary bypass of the circulation.

There are two contraindications to surgery: renal impairment, which is measured with renal function tests before a final decision for surgery is made, and cardiac decompensation, which is evaluated with preoperative electrocardiograms.

The nurse must be prepared to give psychological and spiritual support as well as physical care. To minimize the stress of worry, the patient is kept sedated preoperatively as much as possible.

The operative procedure usually takes several hours. Postoperatively, it is important that the nurse watch closely for the slightest deviation from the normal recovery pattern.

Intake and output are measured every hour for at least 24 hours after surgery. After the first day, the

doctor determines the frequency of measuring and recording intake and output. If the patient is perspiring profusely, an estimated figure is included in the total output.

Pulse, respiration, and blood pressure are checked every 15 minutes until they are stable and thereafter every hour for at least 24 hours. It is important to know the preoperative measurements so that changes can be reconciled intelligently. Changes in blood pressure, pulse, and skin color are signs of impending shock, and the physician should be notified immediately.

Dressings are checked frequently for staining. If the patient complains of pain in the lower back, retroperitoneal hemorrhage is suspected.

Oxygen is usually administered postoperatively for several hours, and during this time the patient's ability to move is limited. Hence, he is turned every two hours and encouraged to breathe deeply. A scultetus binder may be used to give him a feeling of support.

Peripheral pulses in the extremities are checked every time vital signs are checked. The dorsalis pedis and the posterior tibial pulses are marked with a pen to facilitate subsequent checking. If these pulses cannot be felt, the femoral or popliteal pulse is checked. Obliteration of the peripheral pulse is a first sign of obstruction by an embolus or thrombus at the site of the graft. If there is obstruction, it must be removed promptly.

The patient is apprehensive when he recovers from anesthesia, and the nurse can impart a feeling of security by working in a quiet and reassuring way that suggests that she has planned the patient's care and can cope with any emergency.

The patient is encouraged to cough up mucus every hour to prevent atelectasis and also to ward off prolonged bouts of coughing. He feels more secure and his pain is somewhat diminished if the nurse holds her hand over the incision during the coughing.

The operation involves handling of the bowel, and postoperative flatulence and distention are not uncommon. A rectal tube may be ordered to relieve distention in the lower bowel.

If the patient is on continuous gastric suction, intravenous therapy will be necessary for the first few days to meet nutritional, electrolyte and fluid demands. Bedside care should be planned so that the injections are started after the morning care and completed during the day, so that the patient can sleep through the night. Special mouth care is particularly important when the patient is receiving no oral feedings. If there are no restrictions on food or fluid, small amounts are offered frequently in lieu of larger quantities at conventional mealtimes.

The patient is usually allowed to get up by the fourth day and should be slid out of bed rather than allowed to sit on the edge. This will prevent tension on the suture line and pressure on the popliteals. For

the same reason, the patient is urged to walk rather than to sit when out of bed. By this time he is very dependent and will have to be encouraged to do more for himself each day. The nurse gradually withdraws her support and begins planning home care with the patient.—*Rita Coll, R.N.*, educational director, School of Nursing, Temple University Hospital, Philadelphia.

## Discussion

**Q. What is the source of homografts?**

DR. TYSON: Patients in the autopsy room who have not died of infection, cancer, or atherosclerosis. This leaves essentially only accident victims known to be free of these afflictions. The grafts are removed under clean conditions and then sterilized in liquid ethylene oxide. There is a considerable explosion hazard involved, and the procedure must be carried on in a well-ventilated room.

**Q. Is there any time factor involved in obtaining the grafts?**

DR. TYSON: We like to get them within four to six hours of death.

DR. LEARNER: Lest there be misunderstanding, we should emphasize that the homograft is not a living tissue. It forms a basic structure when introduced in the body, but it is not a viable material. Hence, it should not be thought that a homograft has any advantage over a fabric graft from this point of view.

**Q. Does the administration of anticoagulants over a period of time contribute to the incidence of aneurysms?**

DR. TYSON: Anticoagulants prevent thrombosis or slow down the rate of thrombus formation. They in no way affect the incidence of aneurysms.

**Q: What are the causes of aneurysms?**

DR. TYSON: Classically, most aneurysms of the abdominal aorta are the result of atherosclerosis; aneurysms of the arch of the aorta are usually luetic in origin. Others are the result of trauma or bacterial invasion of tissues.

**Q: What are the indications or contraindications for sympathectomy?**

DR. LEARNER: The indications are not entirely clear. The patient who has intermittent claudication and no other complaints referable to the extremity does not usually benefit from sympathectomy. If there is pain while the extremity is at rest, or if there is ischemic ulcer or pregangrenous changes or temperature changes indicating the possibility of gangrene in the near future, sympathectomy may be of some value.

Sympathectomy is not a cure; it may be followed by amputation. There are times when vascular surgery is not possible—for instance, when distal peripheral circulation is not open and there is no point to grafting. It is then reasonable to attempt sympathectomy, even if the possibility of improvement is only slight.

DR. TYSON: The sympathetic nervous system has more to do with blood vessels of the skin than muscles. Sympathectomy will not relieve the pain of claudication but will heal a skin ulcer. This is important because in ischemic disease of the lower leg, the skin is the first line of defense. It takes less blood to keep the skin intact than to heal it once it is traumatized. The first changes that might necessitate amputation are often lesions of the skin.

Sympathectomy is not a traumatic procedure. There are few fears associated with doing it, and if there is any chance for improvement in the patient, it should be done. We have yet to see any complications due to sympathectomy.

**Q. What position should the patient be in after surgery on the lower limbs?**

DR. TYSON: He should move about. There should be no acute flexion or dependence of the distal limb. These patients develop postoperative edema, which is aggravated by having the limb dependent.

**Q. How long is heparin given postoperatively?**

DR. TYSON: We use heparin only while the patient is on the operating table, to inject into the distal vessel when it is occluded. We do not use anticoagulants postoperatively. Occasionally a physician will order heparin for 10 days postoperatively, but he is definitely in the minority.

**Q. What can be done when the vessel to be anastomosed is larger than the prosthesis?**

DR. TYSON: It is gathered or tucked.

**Q. Do you think the practical nurse could perform as scrub nurse in this type of surgery?**

MISS GUZARA: The best person available is used. Status is secondary to ability.

**Q. Are any aneurysms inoperable?**

DR. TYSON: All are resectable. Mortality rates may vary. For aneurysms of the abdominal aorta below the renal arteries, the mortality rate is one to two percent; at the thoracic level, the rate is not much higher. In the abdominal aorta below the diaphragm it is about 10 percent, and in the aortic arch, about 40 percent.

Aneurysms in the ascending aorta are most difficult to repair. The pump-oxygenator must be used, heparin is administered, and there is a great bleeding problem.

**Q. How is blood loss measured during arterial grafting?**

MISS GUZARA: Ten dry sponges are weighed on an ordinary dietetic scale. After 10 sponges accumulate from the field, they are weighed, the dry weight is subtracted, and the result is the amount of blood lost in the sponges. Standards for dry sponges of various sizes are posted convenient to the scale.

**Q. What are the limits of safety for occluding the circulation?**

DR. TYSON: These determinations have been made in animals only. There we find that we can safely

shut off circulation to the leg for two hours. This must not be confused, however, with the use of a tourniquet. In surgery, only one vessel is closed off—a tourniquet occludes the entire circulation. Circulation to the kidney can be shut off for 20-30 minutes with normal temperature; with hypothermia, the time can be extended to 45 minutes. About the same time limits apply to the liver. Circulation to the intestines can be occluded for longer periods.

## *Open-Heart Surgery*

### Describes Ostium Primum, Advises Correction if Possible

Most forms of heart disease represent mechanical defects. Congenital heart disease is an example of standard mechanical difficulty. Ostium primum, for example, is a rent or tear in the septum separating the left atrium from the right atrium. It is significant because the tear is low in the septum at the cushions of the mitral and tricuspid valves, and the valves are frequently involved.

Pressures in the left atrium are higher than in the right atrium, and the flow of blood is ordinarily directed from the left to right. Any increased flow to the right side must be taken care of by the chambers of the right heart, which are well suited for the job. Blood then passes into the vascular channels of the lung.

However, sometimes when there is increased blood flow through the lung, the vessels object, and changes occur which are similar to those occurring in systemic circulation when it is forced to carry additional blood or is working under additional pressures. The vessels become filled with cellular debris which reduces their caliber and ability to carry a load.

Resistance to flow of blood to the lungs increases, and additional pressure builds up in the right heart. The right heart has to work harder to push blood through the pulmonary circulation. The transfer from left to right becomes arrested, and flow goes from right to left.

In some instances, there are no manifestations of trouble. In others, because of the increased load on the right heart and pulmonary circulation, the patient will be prone to respiratory infection or have difficulty in breathing. The upper chambers of the heart are highly irritable, and the patient may have peculiarities of basic heart rhythm. Overwork of the heart results in cardiac failure.

The diagnosis is made by objective examination. Murmurs resulting from the excessive flow across the pulmonary arteries and defects at the valve levels are audible. Peculiarities are detected by x-ray silhouettes. EKG patterns are changed.

One then has to decide whether the patient is better off living with his disease or running the risk of

a surgical procedure. Whenever possible, the lesion should be corrected. A second question is whether the lesion can be corrected at any time. As long as the transfer of blood is from left to right, there is a safe area for correction, but once there are changes in the lungs or pulmonary vasculature and the shift is from right to left, a new approach is necessary. Closing the lesion will not correct pulmonary vascular changes which have already occurred.—*William Likoff, M.D.*, clinical professor of medicine and director, cardiovascular section, Hahnemann Medical College and Hospital, Philadelphia.

## Incidence of Psychiatric Complications Low; Anxiety, Schizophrenia, Depression Possible

There is a low incidence of neurological or psychiatric complications in open-heart surgery. Some disorders are benign and transient; others are serious. There may be a frank neurological disorder, or there may be psychiatric disturbances without any apparent neurological disturbance.

One complication is cerebral embolus. If this is not fatal, some invalidism results. The only sign during surgery is a sudden severe drop in blood pressure. There is usually prolonged unconsciousness after surgery. Twenty-four to 72 hours after the operation, classical signs appear—increased reflexes, spasticity, and so forth.

When there is no objective evidence of brain disease, one thinks of psychiatric disorders such as acute anxiety, schizophrenia, depression, or confusion states. In a series of 1,500 patients, 47 (3.1 percent) showed some aberration of thought process.

Acute anxiety may occur any time during convalescence. The patient may have had anxiety before surgery, but after surgery anxiety floods the consciousness. There is a constant awareness of physical distress. The patient may fear that surgery has been unsuccessful and may live in dread of death.

The acute schizophrenic reaction is characterized by apathy, delusions, and hallucinations. Most cardiac patients develop a passive dependence preoperatively and are shy people. The dependence and shyness seem to be protective mechanisms removing them from reality and stress. They cannot resolve the conflict between consciousness and unconsciousness. Fear of disability may constitute more of a threat than actual disability.

Depth of depression varies. The patient may be perplexed and complain of a feeling of unreality. He may bemoan the strain of the disease on his family. He may have difficulty facing the reality of getting better. As depression deepens, everything is colored by despondency and hopelessness. A feeling of impending doom prevails. This may progress to psychomotor retardation of speech and motion. There is little desire for food. The patient is overwhelmed by

reality, and suicide is a constant threat. (Three out of 47 patients did commit suicide—two while in the hospital and one after discharge.)

When there is protracted delirium and disorientation even without abnormal neurological signs, hypoxia or reduced blood flow is suspected, because psychiatric symptoms do appear following hypoxia.

Most patients regain mental equilibrium without definitive treatment such as shock or insulin therapy.—*B. Marvin Hand, M.D.*, professor and head, section of neurology, Hahnemann Medical College and Hospital, Philadelphia.

## Nurse Should Know Patient as Individual; Pre- and Postoperative Care Outlined

The patient entering the hospital for open-heart surgery has made a major decision and comes in expecting the best in surgical and nursing care. The nurse, to be helpful, must understand the anatomy and physiology of the individual patient's pathology. She must have some ken of the surgical technic for correction, and she needs technical skills to use the mechanical equipment involved in therapy.

She must know every patient as an individual—his needs, fears, and feelings. She must learn to recognize when sympathy, encouragement, and reassurance are needed and when kind, gentle firmness is necessary for the good of the patient.

The preoperative patient may be free of symptoms or may have all the symptoms of cardiac failure. The physician and nurse must exchange information about the patient with each other, and let the patient know that they are a cooperative team working in his best interests.

Blood studies, EKG, x-ray studies, cardiac catheterization, angiocardiography, and four-hourly observations of temperature, pulse, and blood pressure are all part of the preoperative work-up. The patient may or may not have sodium restricted in his diet. Diuretics may or may not be ordered. In all cases, rest is imperative.

Immediate preoperative care begins the day before surgery. The nurse from the maximum-care unit visits the patient and explains what will happen and how he will feel postoperatively. Treatments and the equipment involved are explained. Also discussed are the kind of pain and the amount to be expected, and the technic of coughing and deep breathing.

It is important that the family be prepared, and they and the patient are encouraged to express fears and feelings. Questions are answered when possible, or referred to a proper person when more information is needed.

The afternoon before surgery, the preoperative shave is done. An ankle or wrist is also prepared for venesection. An enema is given, and the patient is

sedated. The next morning, an indwelling catheter is inserted and preoperative medication is given. Whenever possible, the nurse who will care for the patient observes the surgery, in order to understand more intimately the problems involved in recovery.

During surgery, the family is made comfortable in a lounge and kept informed.

The postoperative room is prepared with equipment for administration of oxygen, chest suction, an electric pump, equipment for aspiration, an electric thermometer, and blood-pressure apparatus. A hypothermia blanket is put on the anesthesia bed.

When the patient reacts, he is brought to the maximum-care unit. He is usually oriented and able to cooperate to a degree. He is placed in semi-Fowler's position. The chest tube is attached to water-sealed drainage to withdraw fluid and allow for re-expansion of the lungs. Absence of drainage or excessive drainage of frank blood must be reported promptly. The indwelling catheter is connected to drainage equipment. Oxygen is given by nasal catheter until the physician thinks that the patient can get along on his own.

Intravenous fluids are given continuously for two to three days and are run in slowly to prevent strain on the heart and circulatory system. If the patient is allowed anything by mouth, only small amounts of water are offered. Intake and output are accurate for electrolyte balance measurements. The rectal temperature is taken continuously, and vital signs are checked every 15 minutes for 24 hours.

I. S. Ravdin, M.D., professor of surgery, University of Pennsylvania School of Medicine, Philadelphia, and president, American College of Surgeons, posed willingly with Dean Theresa I. Lynch (l.) of the University of Pennsylvania School of Nursing, consultant to the ACS on the programs for nurses, and Iris Ann Machlan, R.N., Philadelphia, chairman of the nurses' advisory planning and arrangements committee.

The depth and rate of respiration and the quality of chest expansion are particularly noted. The color of lips and nails is watched. The patient is not turned for the first 24 hours. Thereafter, he may be propped slightly toward the unoperated side. He is not turned on the operated side until the tube is removed.

The first two to three postoperative days are most critical. Pain is severe and is controlled with fre-

quent small doses of narcotics. Coughing and deep breathing must be encouraged to prevent retention of secretions, atelectasis, and cardiac failure. The pain associated with them causes apprehension. They are eased if the narcotic is administered 20 to 30 minutes before the breathing episode and if the chest wall is splinted with the nurse's arms or hands. Tracheal suction is used if necessary, and the positive-pressure mask is also useful in encouraging deep breathing.

Cardiac medication is continued postoperatively. The patient is urged to move his arms and legs. Blood studies for determining electrolyte changes are necessary the first few days after surgery. Portable x-ray examination will also be necessary.

By the third or fourth day, the patient has less pain but is depressed and irritable. He needs reassurance. When the chest tube is removed, turning, breathing, and moving are easier. Diet progresses with a restricted salt intake. The physician gives very specific instructions for ambulation. Dyspnea, fatigue, and an increased pulse rate are likely during this time.

The patient leaves the maximum-care unit by the end of the first week. Thereafter he is weighed daily, and vital signs are checked every four hours. Before discharge, the patient and his family are instructed in the details of convalescence and follow-up.—*Catherine L. Winterle, R.N.*, clinical instructor in medical-surgical nursing, School of Nursing, Presbyterian Hospital, Philadelphia.

## Patient Needs Real TLC, Not ICE, Says Priest

Nurses must build up a patient's confidence preoperatively and his patience postoperatively. They must radiate faith and goodness. Patients need love; they need true TLC in contrast to the ICE (ice-cold efficiency) so often tendered. Nine out of 10 believe in God and the nurse should not hesitate to pray with them.

Surgeons need to remember that the patient unconscious for days is still a human being. Bad news must be broken gently. If there is some question as to the future of the patient, this can be admitted, but a little qualification, such as "perhaps" or "maybe" may be preferable to a statement of absolute certainty.—*The Rev. Stephen Landherr,* C.S.S.R., moderator, Archdiocese of Philadelphia.

(*Abstract of a paper from the 1961 clinical congress of the American College of Surgeons*)

## Processed Calf Bone Gives Good Results in Animal Experiments

Highly encouraging results have been obtained in experiments using processed calf bone in transplants into dogs.

Gross, radiographic, microradiographic, and histologic examinations showed that heterografts, although 0.5 cm. longer than autografts, were initially accepted by the host as well as autografts and subsequently were remodeled more rapidly. Although the more rapid remodeling of the heterograft is inexplicable, two possible explanations seem worthy of consideration:

(1) The marrow vascular space is larger in rapidly growing calf bone, and (2) fat had been removed from the heterografts and not from the autografts. It is conceivable that altered fats in the autografts might retard either cellular invasion or osteogenesis, or both.

This study indicates that the technics used to lower antigenicity of calf bone did not adversely affect its biomechanical properties. Although the cellular response to both types of bone was almost identical at 30 days, a comparison between fresh and processed heterografts is necessary before the effect of this technic on the "homograft inflammatory response" can be determined.

These data justify clinical evaluation of preserved calf bone as a substitute for preserved homogenous (bank) bone in selected cases.—*C. Andrew Bassett, M.D.,* and *Daniel K. Creighton, Jr.,* orthopaedic research laboratories, department of orthopaedic surgery, Columbia University College of Physicians and Surgeons, New York City.

*(Abstract of a paper from the 1960 clinical congress of the American College of Surgeons)*

## Adding Calcium Makes Stored Blood OK for Heart-Lung Operations

Conversion of ordinary stored bank blood for use in operations involving heart-lung machines has been achieved by the addition of calcium salts. "Citrate toxicity" has long been given as the reason for the use of heparinized fresh blood in such operations, despite the many deficiencies of heparin as a blood preservative compared with ACD solution. This toxicity can be reversed by the addition of calcium.

An extensive comparison of the physiological effects of heparinized blood and ACD blood converted with heparin and calcium was carried out in a series of 18 patients undergoing extracorporeal circulation. ACD blood was used in 10 cases and heparinized blood in eight. The two groups of patients were indistinguishable in white-cell count, hematocrit, clotting time, postoperative bleeding, electrocardiogram, electroencephalogram, and the pressure measurements.

An increased heparin dosage may be desirable to achieve the same circulating heparin level present in patients receiving fresh heparinized blood.—*Andrew V. Foote, M.B., Michael Trede, M.D.,* and *James V. Maloney, Jr., M.D.,* department of surgery, University of California Medical Center, Los Angeles.

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By Dorothy W. Errera, R.N.

### Surgical Technics

Evans, Joseph P., and Keegan, Harold R.: "Danger in the Use of Intrathecal Methylene Blue." *J.A.M.A.* 174:857, October 15, 1960.

For about 30 years, blocks in ventricular systems have been traced through colored ventricle fluid achieved by injecting methylene blue into the cerebral ventricles. Sporadic reports of adverse effects have never discouraged use of the technic.

The authors of this report have collected convincing evidence to confirm the danger of methylene blue in the subarachnoid space. The dye is promptly diffused in cerebrospinal fluid, irritates cranial nerves, and obstructs cerebrospinal fluid pathways. The neurological changes in 14 cases are tabulated.

King, John Harry, Jr., and Chavan, Shankar B.: "The Preservation of Eye Tissues. Part 3—Current Status in Transplantation." *Bull. Georgetown U. Med. Center* 13:87, November 1959.

Cornea, conjunctiva, sclera, and vitreous can be preserved and stored for elective surgery.

Cornea may be dehydrated in 95 percent glycerine, sealed under vacuum, and stored at room temperature.

Vitreous may be lyophilized (rapid freeze-dried), vacuum-sealed in tubes, and stored at room temperature.

Conjunctiva and sclera may be dehydrated and freeze-dried with or without glycerine pretreatment. There is no data available on results with human transplants, but in animals, normal conjunctiva and sclera were indistinguishable from transplanted tissues once healing was complete.

Lens have not been successfully preserved or transplanted.

Emneus, Hans: "Experimental Investigation of Corrosion of Stainless Steels Used in Bone Surgery." *Acta Orthopaedica Scandinavica*, Suppl. XLIVb, 1961.

When a foreign body such as a surgical prosthesis is inserted in the body, surgical trauma, infection, mechanical and chemical reactions can be anticipated. The mechanical effect increases in proportion to the size of the implant, but has been accepted in orthopedic surgery as a minor disadvantage when contrasted to the benefits for the patient.

Chemical irritation has been controlled in part by the use of high-alloyed chromium nickel steel (18 - 8) and chromium-nickel-molybdenum steel, but even implants of the latter show signs of corrosion when removed from the body.

Three types of corrosion are common to instruments and component parts used in orthopedic procedures: pitting, crev-

ice, and galvanic. Environment is an important factor; chlorides, for example, are the most active corrosives in body fluids.

Stainless steels become passive—that is, they become covered with a film of chromium oxide and entrapped oxygen which offers protection against all corrosion except that caused by chlorides. When chlorides attack, punctate areas result, and pitting corrosion progresses rapidly. When oxygen is present in the corroding solution, the attack is accelerated. Living tissues with relatively high chloride and oxygen contents are excellent media for pitting corrosion of implants and instruments.

Despite superior passivity of metals in such appliances as Rush pins, Sven Johannsson nails, and Kuntscher nails, all are susceptible to corrosion from stress and cold working (bending, twisting, breaking, cutting) and from metallic transfers of guide wires, pliers, screwdrivers, or other instruments.

Corrosion in a classical bone plate, for example, is aggravated by strenuous cold working of the screw heads and transfer of metal from the screwdriver to screw head. When two different metals or alloys are in contact with crevices, i.e., plate and screw—there is risk of corrosion of the metal which is less "noble." *(In chemistry, "noble" is used to describe a stable material resistant to the destructive effects of oxygen.*—ED.)

In this study, the corrosion-inducing effect of pressure of screw against plate was not evaluated as much as the relationship of the crevice to corrosion. Rods of 832M, 832 SK and 832 SL alloys* were tested in experiments approximating the clinical situation. Corrosion was minimal when contact was at a single spot and increased as the crevice became smaller—that is, as contact increased between two flat surfaces. Corrosion was most apparent with samples of 832M; moderate with 832 SK, and only slight with 832 SL.

The transfer of metal from various tools to plates and screws has been studied and reported elsewhere. In this report, the transfer of metal from various guides to a Vitallium nail was studied. Transfer of tool steel to Vitallium leaves the tool steel susceptible to galvanic corrosion, and rapid dissolution of the steel results. *(In the patient, these metallic ions are deposited in the foreign-body bursa that forms about metallic implants. Electrolytic dissolution of bone in contact with the implant also proceeds until the susceptible metal has disappeared.—ED.)*

*Correlation steel types:

| Avesta Sweden | American Iron and Steel Institute |
|---|---|
| 832 M | 303 |
| 832 SK | 316 |
| 832 SL | 317 |

Vitallium has been demonstrated to have superior resistance to corrosion, and in all the tests performed for this study, it remained corrosion-resistant except in a single instance in which a surgeon heated a plate before bending it to extremes of tolerance. In the experimental situation, a serious risk of gross corrosion accompanied the use of guides made of 832M; minute corrosion was common with 832 SK.

Annealed wire of 832 SL appeared to be so passive that it did not corrode on direct contact with Vitallium and titanium. However, the slightest damage from cold working resulted in galvanic corrosion.

The same risk and order of corrosion accompanied use of the metals with titanium.

Damage caused by marking stainless steel instruments and by careless handling was evaluated by stamping 30 letters on plates of the three steels under study and by making 60 deep stabs with two kinds of screwdrivers (both Stille-Werner; stamping tools used were not named).

The stamping process caused little corrosion of 832M, and surface damage was destructive only when deep. The 832 SL samples tolerated all attacks, deep and superficial, without any signs of corrosion.

Similar plates were then attacked with three types of drills: a high-speed steel drill, a nickel-plated carbon steel drill, and a Vitallium drill. Four holes were made on each plate with each type of drill. Two scratches were made on each plate—one with a chromium vanadium steel screwdriver and one with a surgical screwdriver (Stille-Werner). Steel shavings were removed, and the plates were tested for corrosion.

Every plate of 832M showed corrosion in at least one cavity; all but three of those fabricated of 832 SK showed corrosion, but there was no evidence of corrosion in any of the 832 SL samples.

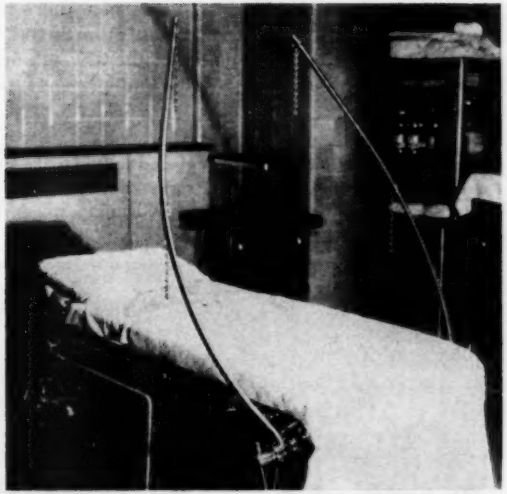
# Vaginal Surgery Leg Holder Proves Boon to Patient, Staff

Proper positioning of a patient for vaginal surgery is one of the most critical aspects of the procedure, but is often the most neglected. The widely used means involve mechanical contrivances which flex the thigh on the abdomen and the leg on the thigh, placing the lumbar spine in the flat or "neutral" position of abnormality.

A new type of leg holder for such surgery has been developed by Edward G. Waters, M.D., Jersey City, N. J., who reports that it has become highly regarded at Margaret Hague Hospital, and is used by the staff for most vaginal surgery performed.*

The holder is simple to use, and affords facility and convenience for the nurse in draping the patient satisfactorily in the extreme of the lithotomy position. The preparation of the operative field is easier, and draping under the buttocks provides safety from contamination.

The holder has been used in several hundred surgery cases, without any untoward reactions. It is es-

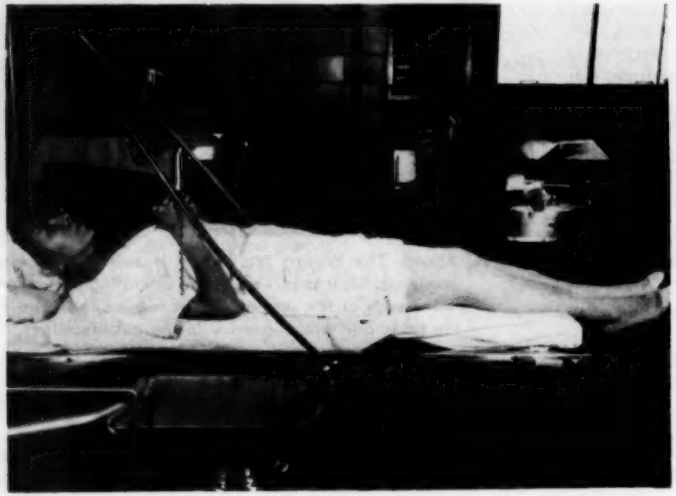


Above: The Waters leg holder is made of tubular steel, and fits into sockets on the operating table. Forward ends of the supports point toward the head of the table and are aligned with the outside edges.

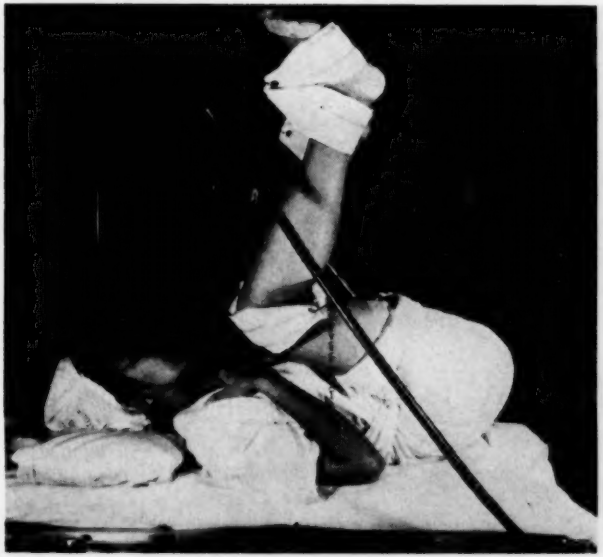
*The holder is presently being manufactured by the Swan Engineering Co., Bloomfield, N.J.

pecially good in the elderly patient since there is no acute flexion of any joints involved by arthritis. Patients up to 85 years of age, and others weighing up to 320 pounds have been easily and properly positioned.

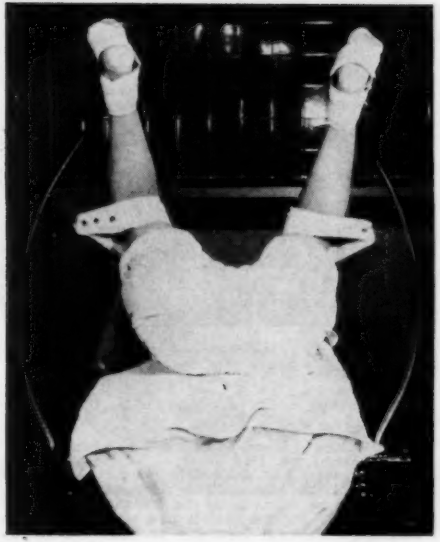
Below: Patient is placed in normal position with the base of the spine on a line between the two locking socket devices. The "S" on the patient's side shows positioning of the superior iliac spine; the "T" represents trochanter.

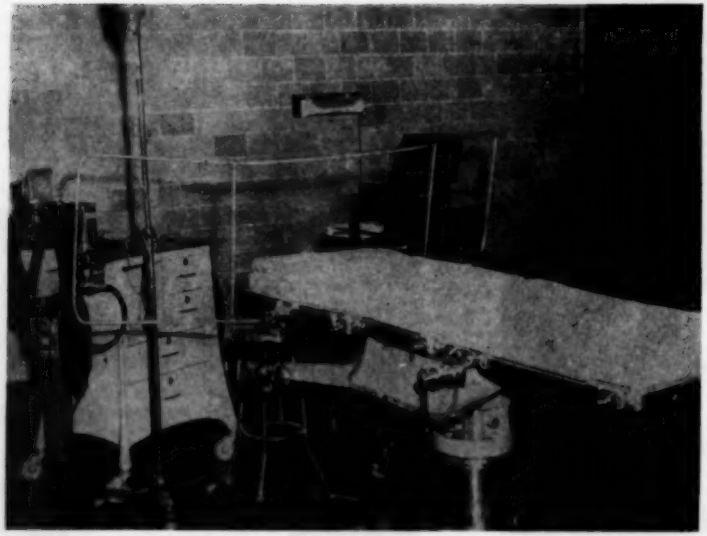


Below: Sponge is inserted in zippered sections of support slings. The knee and foot are placed in the slings, and "S" hooks attach the slings to chains on the holder.



Patient shown comfortably in the holder, on the full breadth and length of the back. This gradual positioning bend makes for excellent expanse in all ages, including patients with arthritis, ankylosis of the knees, and other limiting conditions. The L-shaped foot slings fit around the patient's feet, forming a shoe. The knee supports are loosely applied, and serve only to stabilize the patient and keep the thighs from pressing in the center of the abdomen.





The improved screen in place on operating table.

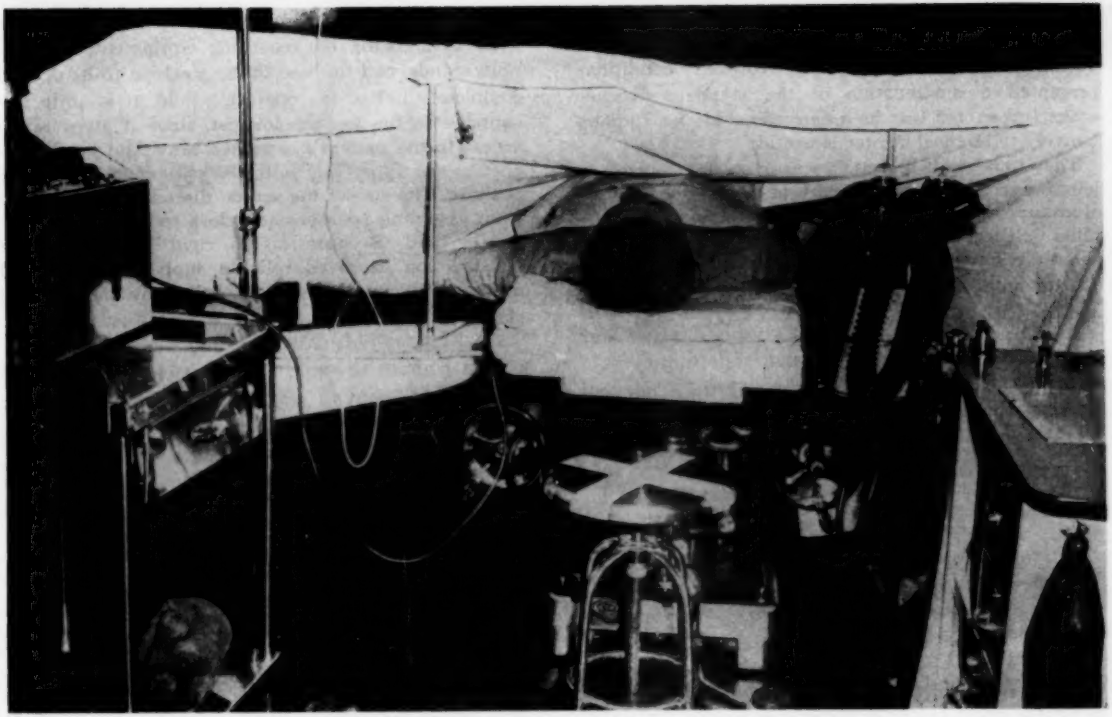
# An Improved O.R. Screen

By Dean H. Morrow, M.D.**

*This article is based upon material which appeared originally in the May-June, 1959, issue of *Anesthesiology*. The editor of *Anesthesiology* has granted permission for publication of the article and the accompanying illustrations.

**Dr. Morrow, formerly at the Indiana University Medical Center Hospitals, Indianapolis, is now with the department of anesthesiology, National Institutes of Health, Bethesda, Md.

The progressive advances of anesthesia and surgery are leading to more extensive and more detailed kinds of operative procedures. Many of these surgical undertakings, of necessity, require the presence of additional personnel and equipment in the oper-



The screen with drapes in place and the patient ready for surgery.

ating room. The need for maintaining the necessary aseptic barrier between the operating team and the anesthesiologist under these crowded conditions prompted a modification of the standard Kocher ether screen for use in major cases at the Indiana University Medical Center Hospitals.

The improved screen, measuring 60 inches in length and 22 inches in height, is made from ½-inch aluminum rod. It fits the standard ring adapters supplied with the operating tables. The illustrations show the screen attached to the operating table, and the advantages of the screen with drapes in place and the patient ready for surgery.

It has been found to be quite pleasing to the surgeon in allowing all recording equipment, intravenous stands, and the anesthetic machine to be draped completely out of the operating field. It is quite acceptable to the anesthesiologist, since it gives ready access to the patient's extended arms and good support to the upper arm with the patient in the lateral position. The size of the screen discourages observers from assuming positions too close to the wound and sterile field. Because of its rigid yet lightweight construction, it gives reliable support for surgical drapes and may be easily handled by the nursing staff.

# Cardiac Arrest — Is Potassium a Factor?

Cardiac arrest has been noted to occur in some cases after massive transfusion with bank blood. The possibility that potassium injected in the form of hyperkalemic bank blood was causing the cardiac arrests was considered by Harry H. LeVeen, M.D., chief, surgical service, Veterans Administration Hospital, Brooklyn, N. Y. He and his colleagues conducted a series of experiments on laboratory dogs, and made a survey of a number of clinical cardiac arrest cases in humans.

During the storage of bank blood, a rise in the serum potassium is caused by leakage of potassium from the red blood cells. Dogs made slightly hypotensive and injected with potassium solution at rates equivalent to the rapid transfusion of bank blood, experienced cardiac arrest. However, there was more potassium in specimens taken of the heart's blood than could be accounted for on the basis of injections.

All the vessels in the region of the heart were cannulated, and it was found that the extra potassium was being liberated from the liver. Internists have long known that patients frequently become hypokalemic during insulin therapy for diabetic coma. The explanation lies in the fact that one mole of potassium is chemically bound to each mole of glucose deposited in the liver, causing a hypokalemia.

The reverse situation is important to surgeons. Adrenalin releases glucose from the liver; potassium is also released. This mechanism is the core of the pathogenesis of cardiac arrest.

Bank blood is a source of exogenous potassium, and the liver is a large source of endogenous potassium. In some cases it is not necessary to have extra potassium injected in the form of bank blood, because sufficient potassium can be released from the liver to cause cardiac arrest by this mechanism alone.

**Leo A. Sapirstein, M.D., Ph.D. (l.), professor of physiology, Ohio State University, Columbus, questions Harry H. LeVeen, M.D., chief, surgical service, VA Hospital, Brooklyn, N. Y., on the latter's display exhibiting results of an investigation into the relationship of serum potassium to cardiac arrest.**

Next, Dr. LeVeen and his associates examined a series of 157 clinical cases to find the frequency of cardiac arrest from various causes. In 50 of the 157, bleeding and transfusion was the primary etiologic cause.

In those patients in whom cardiac arrest was produced by transfusion alone, the average dose of potassium was 77.7 mEq. In those patients in whom the transfusion of blood was contributory to the cardiac arrest, the total dose of potassium given was 57 mEq.

Methods of reducing the concentration of potassium in stored blood were investigated. Packets of ion-exchange resin exchange sodium for serum potassium in old bank blood, and have been found effective in keeping the plasma potassium level from rising above 5 mEq. even after three weeks' storage.

The resin is contained in a plastic bag which is permeable to alkaline metal ions.

Considerable care must be exercised in using blood treated in this way. Ion-exchange resin acts immediately, and unless the blood has been stored for a considerable time, and has built up a high potassium content, massive transfusion of this resin-treated blood might be expected to cause significant hypopotassemia.

Based on his clinical and experimental studies, Dr. LeVeen has formulated several recommendations on the management of patients to avoid cardiac arrest.

1. Hypovolemia should be avoided. Hypovolemia triggers the adrenalin mechanism and causes a release of potassium from the liver. Only the conductivity method for blood-loss management is sufficiently accurate for this purpose. If blood loss is carefully measured, the need to suddenly pump bank blood will be minimized.

2. The pumping of bank blood should be avoided, since this delivers a sudden load of potassium to the heart. In addition, the rapid pumping of cold blood at times when venous return is markedly diminished can produce selective refrigeration of the heart and spontaneous fibrillation will result.

3. If massive blood losses are expected, fresh bank blood should be used. In those cases of cardiac arrest where bleeding and transfusion was the primary etiology, Dr. LeVeen noted that over 3,000 cc. of blood had been given in every case, and most cases had received more than 4,500 cc.

4. Insulin and digitalis can be used to combat potassium intoxication. Ten units of insulin are given intravenously in the infused tubing; glucose is given continuously. Hypoglycemia must be avoided since it also produces adrenalin release. The glucose and insulin merely make sure that glucose is not being released from the liver, but is being deposited, which prevents the release of potassium. The patient can be digitalized rapidly by the administration of cetalanid.

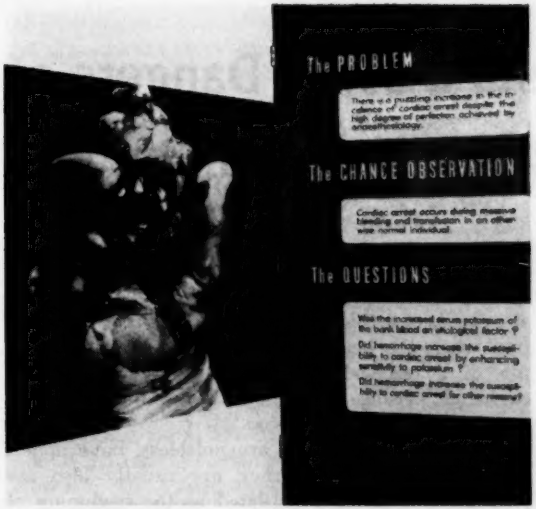
A rise in venous pressure is a signal that cardiac arrest is impending. However, if blood loss has been

properly measured, this rise can be distinguished from overtransfusion and is a sign of potassium intoxication.

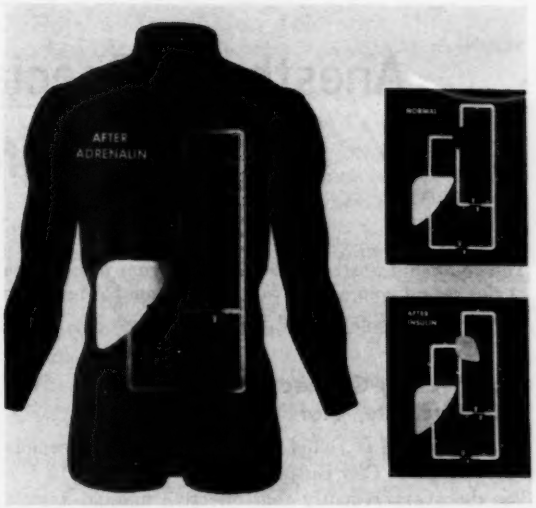
5. The use of adrenalin should be avoided at all times. Adrenalin serves to stimulate the heart, but it releases extra glucose and potassium from the liver, and cardiac arrest recurs, making the situation worse than it was originally.

The results of Dr. LeVeen's experiments have been collected and graphically transformed into a display titled "Control of Cardiac Arrest." The extensive presentation was exhibited at the 1960 meeting of the American College of Surgeons.

Dr. LeVeen's extensive exhibit takes the viewer through the experiments step by step, and presents the results in diagram and graph form.


The PROBLEM
The CHANCE OBSERVATION
Cardiac arrest occurs during massive bleeding and transfusion in an otherwise normal individual.
The QUESTIONS

Two of the more dramatic sections of the exhibit were the opening, which stated the problem, the observations, and the questions which led Dr. LeVeen and his associates into the potassium study; and a diagram graphically depicting the role of adrenalin in the release




of potassium by the liver. Experimental adrenalin injections actively elevated the hepatic vein serum potassium up to 25 mEq. of potassium. Conclusions drawn indicate that hyperkalemic bank blood plus hepatic potassium release can cause cardiac arrest.

# Anesthesia Specialists Discuss Dangers of Transfusions, Vascular Surgery

*The following abstracts were taken from talks given at the recent congress of the International Anesthesia Research Society, held in Houston, Texas.*

## Closed-Chest Cardiac Massage Will Circulate, Not Ventilate

*Peter Safar, M.D.*, chief, department of anesthesiology, Baltimore City Hospital:

The discovery recently that effective manual systole is possible without opening the thorax has prompted several questions about the new method, and comparisons of it with the older open-chest method.

The first question you might ask is "Can the method circulate blood"? The answer is yes. In cardiac arrest patients with absence of sternal pressure, there was either a blood pressure of zero recorded, or EKG evidence of ventricular fibrillation. With sternal pressure, blood pressure neared normal.

The method cannot be relied on, however, to adequately ventilate the lungs. It has previously failed, as in cases of artificial respiration. This is particularly true when the head is unsupported. In spite of the use of a tracheal tube, there may still be zero exchange because of a decrease of lung capacity, and increased surface tension.

Cardiac arrest patients are pulseless, have apnea, are unconscious. Since they are usually also asphyxiated, lungs are ventilated at the beginning of resuscitation. One operator should ventilate, one apply sternal pressure. A third operator, when available, should feel the femoral pulse.

How should ventilation and sternal pressure be combined? If the first operator inflates and the second operator squeezes the chest at the same time, they will be unable to tell if the chest moves, or if the airway is obstructed, particularly in cases without a tracheal tube. We are teaching our teams to

inflate, pause, then apply sternal compression. It is possible for one operator to accomplish all parts of the procedure, but exceedingly difficult, since pressure of both hands is required for sternal compression. However, when resuscitating children, the pressure of one hand is sufficient, and one thumb is enough in infants.

Is the closed or open-chest method mechanically more effective in circulating blood? In our laboratory test with dogs with fibrillations, we could find no significant difference in blood flow and arterial pressure between the two. Control values in both groups varied from seven to 43 percent.

It is impossible to compare efficacy of the two methods in man, since there are too many other contributing factors. The actions of vasopressors, cardiac massage, blood transfusions all interfere with such a comparison. The open method allows adaptation of the rate of compression to filling of the heart. However, the closed-chest method may be begun earlier.

There is some trauma involved in closed-chest cardiac massage. Fractured ribs and costochondral separation appear in the majority of adults. Only one of our survivors has been treated for a crushed chest. To eliminate trauma as much as possible, pressure should be placed on the lower half of the sternum only, and no greater pressure should be applied than is required to produce a palpable artificial pulse.

## Age, Duration of Surgery Factors in Transfusion Tolerance

*Joseph F. Ruscio, M.D.*, associate visiting physician, Boston City Hospital:

Administering anesthesia to a patient with acute hemorrhage is a further insult to an already critical condition.

In a recent study, our test sample of patients was of the older age group, carrying with it debilitating conditions associated with advancing age. Diseases of the heart, lungs, liver, kidneys, and endocrine systems were among the most prevalent. There was also an accompanying feeling of apprehension, and psychological problems posed difficulties to the anesthesiologist.

The test, run from January, 1958 to December, 1960, had these criteria for selection of test patients: they must have had an emergency operation, must have gone into shock on admission to the hospital or just prior to admission, and have received five or more units of blood.

The test total of 123 patients were divided into two further groups: those that survived and those that did not. The group numbered both males and females, and 54.5 percent were survivors.

Groups were divided again, according to surgical procedures performed. These persons were predominantly gastric bleeders, the majority with full stomachs. Most were alcoholics of long standing.

In the survival group, a total of 631 units of blood were given, or 9.4 units per patient. In the non-survivors, a total of 743 units were given, or 13.2 units per patient.

Transfusing large amounts of stored blood can cause citrate intoxication. During the large transfusion, it is difficult to tell whether hypotension is due to low blood volume or low serum calcium.

One gram of calcium chloride was administered after six units of blood were given, and one gram given with each additional four units. Ninety-three patients received the calcium; 48 expired. Of 41 patients not given the calcium, eight expired.

Operation time was another factor which emerged from test data; in the survivors group, average time spent was two hours, 45 minutes. Average operation time in the expired group was four hours 15 minutes. Mean average age of the survivors was 50.3, while the age of the expiring group was 58.4, of whom 65 percent were over 60.

## Major Vascular Surgery Poses Inherent Anesthesia Problems

*Charles H. Williams, M.D.*, clinical associate in anesthesia, Methodist Hospital, Houston; clinical assistant in anesthesiology, Baylor University College of Medicine, Houston:

Anesthesia problems in major vascular surgery are not always readily apparent, but they must be considered an inherent danger. The aim of therapy in such situations is first, the restoration of blood flow.

"No wonder he yelled 'ouch'—we're out of gas."

Hypotension is the most frequent complication in vascular surgery. The condition has a multiplicity of possible origins, and is usually reversible. Promptness in dealing with hypotension is essential. Aortic pressure drops; coronary flow may be reduced up to 50 percent despite compensatory dilation. Even transient hypotension may precipitate further myocardial damage in an already damaged heart. Such patients have a predilection to cerebral thrombosis in intracerebral circulation.

Maintenance of adequate pressure is a first consideration. Temporary shunts and bypass grafts are employed when severity of the hypotension warrants.

Sudden massive blood loss (1500 to 2500 ml.) carries with it the inherent possibility of catastrophe. Profuse bleeding (500 to 1000 ml.) may occur, with blood appearing at suture lines and pores. Surgical technic will, of course, influence the amount of bleeding, and study of the patient preoperatively will reduce hazards.

Reactive hypotension may appear in the patient who is less seriously ill. This is characterized by a sudden drop in blood pressure. There may be a sudden drop in diastolic pressure. There may be a sudden decrease in systolic pressure following revascularization. In the cases of renal hypotension, pressors are administered several days, sometimes weeks after surgery. Myocardial infarction in these cases is not unusual.

Moderate precipitous increases in systolic pressure seem to have little effect on the heart even though arrhythmias may be more prevalent at elevated levels. In contrast, the intracerebral vascular system may be vulnerable to transitive hypertension and vascular rupture may result.

Depth of anesthesia and its masking of symptoms may delay recognition of the transfusion of incompatible blood, or of a build-up of potassium in a massive transfusion of banked blood. In the case of high potassium content, cardiac arrest may occur. The situation is more dangerous when the artery has been cross-clamped; concentrations may prove more toxic to the heart.

The transfusion of bank blood has, in the past, caused a mild hypothermia, which can be an important factor in cardiac irritability. Presently, the practice is to heat bank blood to 37°C. to avoid even a mild cooling.

Blood coagulability can be lost in massive transfusion. Unfortunately, this reaction to stored ACD blood is impossible to predict in a given patient. Immediate administration of fibrinogen, transfusions of fresh, whole blood, and large doses of cortisone can alleviate what is a potential danger.

Mortality rates in the cases of ruptured aortic aneurysms range as high as 50 percent. Severity of

the shock varies with the duration of the surgery. A leaking or a rapidly enlarging abdominal aneurysm near rupture is attributable to the increased abdominal pressure occurring during the excitement phase. Complete rupture with exsanguination is not uncommon following induction of these patients.

The ensuing few minutes after surgery, when the vascular surgery patient is moved, lifted, and divorced from some supportive measures, can be a particularly dangerous time for him. Recovery or intensive-care rooms should be utilized as indicated. Complete resuscitation equipment including respirators and defibrillators should be available in case of cardiac arrest. Most important to the patient is the early detection of trouble, and concentrated nursing care.

*The following abstracts are taken from papers presented at the 1960 meeting of the American Society of Anesthesiologists.*

## Jet Nebulizer Proves Safer, More Effective in Ether Anesthesia

We have used a jet nebulizer in anesthetic procedures in more than 2,000 cases over the past four years. An 18-gauge needle is used as the jet nozzle, to which a nipple is fused for attachment to an oxygen line (see illustration). A 20-gauge needle is used as the entrainment duct. The needles are soldered at right angles to each other in an adapter in order to produce a Venturi effect. The unit is then placed in a 2¾″ copper pipe to which conductive tubing is fitted. The jet can be used independently as a vaporizer or incorporated into any system of anesthesia.

The jet is powered by a tank of oxygen and regulated by a compensated flow meter which accurately determines the flow of gases being forced through the jet nozzle. The Venturi effect is accomplished by the increased velocity of gas being forced through a constricted opening, causing a lateral negative pressure at the mouth of the entrainment duct. With this device we can be certain at all times of an accurate steady concentration of entrained fluid, since the amount entrained is always in proportion to the liter flow.

Our first use of the jet was to entrain liquid ether and break it up into fine droplets which are vaporized on their way to the patient. Vaporizing ether this way has a decided advantage over vaporization which takes place in the wick and bubble-type vaporizers. In the latter, the temperature of the liquid ether drops considerably, causing a drop in the concentration of ether being delivered when no auxiliary heat source is used.

In a properly constructed jet a steady concentration of ether vapor can be maintained using one-tenth liter to 10 liters flow of $0_2$ per minute. We have never had the experience of vaporized ether

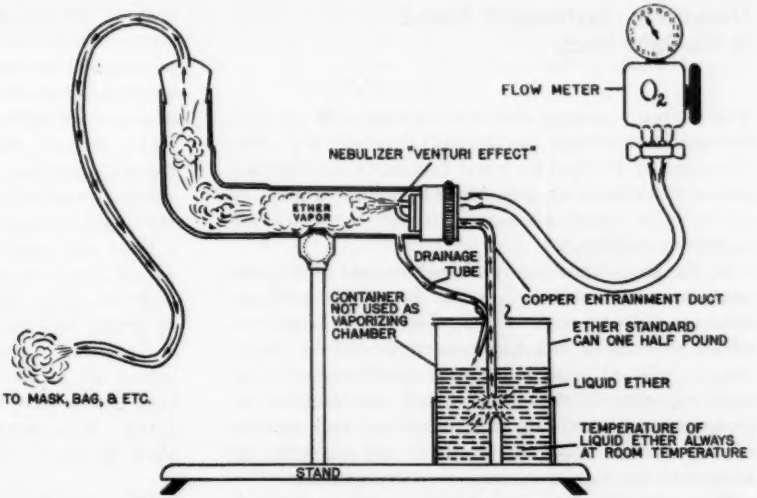



Diagram of jet nebulizer used in ether anesthesia procedures.

condensing out as a liquid. Any liquid (e.g., water) that accumulates usually is condensed and drained into the reservoir bag or drainage tube before reaching the patient.

In the event a static spark explodes the ether vapor at the mask or bag while the jet unit is being used, the reservoir of ether remains intact. Not so with the conventional wick vaporizer in a glass jar; our experiments show explosion results catastrophic.

Aerosoled water along with ether vapor makes for a pleasant mixture, tolerated even by a conscious patient, and can somewhat offset the profound drying effects of both ether vapor and oxygen.

We have also used the jet system with other aerosols. Using the jet to carry a topical anesthetic while administering an intravenous barbiturate has enabled us to laryngoscope and even bronchoscope without the production of laryngospasm.—*Robert A. Berman, M.D.*, St. Joseph Hospital, Far Rockaway, N. Y.

## Nebulizers, Exchangers Tested In Humidity Study

The proper warming and humidification of inspired air serves to reduce postoperative pulmonary complication by preventing crust formation and inspissation. Conventional methods for humidifying inspired air such as nebulization and oxygen tents are not entirely satisfactory.

In our study to measure humidification of inspired air, normal volunteer subjects breathed for half-hour periods through a nonrebreathing system in which all expired moisture was condensed by freezing to −70° C. and determined gravimetrically. In each experiment, the oral inspired and expired air temperatures, humidity of inspired air, and number of respirations were determined. All expired gas was collected and measured in a spirometer.

The normal water loss during oral breathing in 26 experiments on three subjects was 27.7 mg. per liter, and was directly proportional to the minute volumes between three and 19 liters per minute. The net water loss from the respiratory tract decreased as the absolute humidity of the inspired air increased.

In nine determinations on anesthetized patients, the expired absolute humidity was 23.4 mg. per liter, a water loss of approximately 12 cc. per hour.

In 16 determinations, the Wally tube reduced the water loss by one-half. When the absolute humidity of inspired air was 14.0 mg. per liter, the subjects were in respiratory water balance, and at higher absolute humidity of the inspired air a positive water balance was obtained. Under the usual conditions employed with oxygen tents and nebulizers, subjects expired more water than they inhaled and remained in negative respiratory water balance.

Heat and moisture exchangers were found to be as efficient, or more efficient than nebulizers. In addition, they do not produce droplet formation. In order to obtain respiratory water balance, heat and moisture exchangers tested required that inspired air at room temperature be at least 60 percent saturated.—*Yong H. Han, M.D.*, and *Harry J. Lowe, M.D.*, department of anesthesiology, Roswell Park Memorial Institute, Buffalo, N. Y.

## Cold-Trap System Reveals Dehydration of Respiratory Mucosa

When an endotracheal tube is used in anesthesia, the warming, moistening, and recondensing functions of nose and pharynx are bypassed, creating a situation where the tracheal mucosa may dehydrate. It is possible that some postanesthetic pulmonary complications may be due to such dehydration rather

than to trauma from endotracheal intubation and ineffective ventilation due to painful wounds.

Our study endeavors to measure water loss from the lungs when the subject breathes through an anesthesia mask from an anesthesia machine with varying degrees of rebreathing.

Subjects breathed oxygen from a McKesson anesthesia gas machine fitted with a Roswell Park absorber and a plastic mask casting with rubber directional valves. The anesthesia mask was heated only enough to prevent condensation of moisture.

Expiratory samples were drawn from the heated mask by way of a heated tube to a cold trap consisting of a previously weighed U-tube immersed in a solid $CO_2$-methyl alcohol bath, and finally collected in a weighted Benedict-Roth spirometer. The cold trap caused quantitative precipitation of all moisture.

The subjects were adults of both sexes ranging in weight from 64 to 94 kg. The effect of three conditions on specific water loss was investigated:

1. Anesthetic system conditions; subject supine, breathing through nose at normal rate and volume.
   a. closed system, corrugated breathing tubes wet.
   b. semiclosed system with 5-liter inflow, breathing tubes wet.
   c. open system, breathing tubes wet or dry.
2. Tidal volume variation; subject seated, breathing tubes dry.
3. Comparison of nasal and oral breathing; subjects supine, breathing tubes dry.

With the subject breathing by mask, a progressive water loss was evident in each of seven subjects as the system was varied from closed or complete rebreathing through semiclosed or partial rebreathing to open or nonrebreathing. This progressive water loss was statistically significant. When the studies with the open system were repeated using dry tubes, water loss was almost doubled. Water loss increased as inhaled gases were diluted with increasing proportions of dry gases and as tidal volume increased. Water loss by oral breathing was slightly greater than water loss by nasal breathing.—*Harold F. Chase, M.D., Mearl A. Kilmore, M.D.,* and *Robert Trotta, M.D.,* Jefferson Medical College, Philadelphia.

# SPINAL ANESTHESIA — Presentation of A Safe Technic Used in over 50,000 Cases

By Edward R. Malia, M.D., Jack Strom, M.D., M. A. Lucas, M.D., and J. K. Potter, M.D.*

Subarachnoid block has waxed and waned in its popularity since its introduction by Von Bier in 1898. The popularity of the muscle relaxants as well as the fear of medicolegal suits have contributed to the decline in enthusiasm for subarachnoid block. This latter trend has caused many anesthesiologists, in selecting anesthetics, to consider the medicolegal risk rather than the patient's welfare.

Many recent studies have demonstrated the safety of this technic and have found complications attributable to the anesthesia extremely rare or nonexistent. Also, investigation found the mortality from spinal anesthesia lower than that recorded after general anesthesia. The work of Beecher and Todd in analysis of anesthetic deaths casts considerable doubt upon the belief that muscle relaxants are as safe as some proponents would suggest.

Since 1934, at Huron Road Hospital, Cleveland, Ohio, over 50,000 spinal anesthetics† have been administered with the following results:

| *Major Complications* | |
|---|---|
| Death | 0 |
| Paraplegia | 0 |
| Cauda equina syndrome | 0 |
| Infections | 0 |

*From the Department of Anesthesiology, Huron Road Hospital, Cleveland. This article is reprinted with permission from THE BULLETIN, Huron Road Hospital, Scientific Exhibit Issue, Vol. 6, No. 2, May 1960.

†54,985 as of December 31, 1959.

| *Minor Complications* | |
|---|---|
| Transient paresthesia | 6 |
| Headache: | |
| Postsurgical | 1.4% |
| Post-OB | 2.3% |

Spinal anesthesia has been used for all types of surgery below the diaphragm, and it is the purpose of this report to present a clinically proved method of administration.

We feel that four main factors are responsible for our results:

*a.* Strict adherence to a prescribed method.
b. Absolute asepsis.
c. Minimal drug dosage.
*d.* Use of a directional, pencil-point needle.

These factors will be covered in some detail.

### *a. Adherence to method*

There are many ways to perform spinal anesthesia. It was felt, however, that one good method should be adopted and taught to all residents. Uniformity of method would eliminate the hazards inherent in a multiple method program. This uniformity encompasses every detail from the arrangement of the anesthetic table to the position of the patient during and after injection. Special emphasis is placed on the technic of lumbar puncture. This is carried out with the patient in the sitting position using the lumbar interspace best suited between L2-5.

### *b. Asepsis*

All drugs and instruments are autoclaved. Needles and syringes are carefully cleaned in sterile water before autoclaving. To avoid possible neurological complications attributable to detergents, none are used. Syringes and needles used are *only* for spinal anesthesia and are kept separate from instruments used elsewhere in the hospital. Table packs containing sterile towels, forceps, cups, and syringes are prepared in advance. Needles are separately packaged in sterile test tubes and are added to the table immediately before use.

The anesthesiologist scrubs and gloves before touching any of the syringes or needles on the spinal table. The circulating nurse then pours antiseptic into a medicine cup on the spinal table.

The patient is properly positioned in the sitting posture by nurses or orderlies, and a large area of the back is prepared with the antiseptic, using forceps and sponges. Three applications of antiseptic are made; a dry sponge is then used to wipe free of antiseptic an area over the puncture site.

After a suitable skin wheal is raised with procaine, an introducer is placed. In this way, the lumbar puncture needle can be inserted without touching the patient's skin. Contamination of the subarachnoid space by antiseptics or skin bacteria is reduced by this simple procedure.

### c. *Drug dosage*

Tetracaine (Pontocaine®) in hyperbaric solution and dibucaine (Nupercaine®) in hypobaric solution are the drugs used. Both are 0.2% concentration.

Preparation is as follows:

| | |
|---|---|
| Tetracaine—0.3% in 6% dextrose | 2 cc. |
| Ephedrine—5% | 1 cc. |
| Resulting solution contains: | |
| Tetracaine 2 mg/cc. | 0.2% |
| Ephedrine 17 mg/cc. | 1.7% |
| Glucose 40 mg/cc. | 4 % |
| Dibucaine—0.5% aqueous | 1 cc. |
| Epinephrine—1:1000 | 0.3 cc. |
| Water | 1.2 cc. |
| Resulting solution contains: | |
| Dibucaine 2 mg/cc. | 0.2% |
| Epinephrine 0.12 mg/cc. | .012% |

Readers are referred to the article by Whitacre and Potter on the subarachnoid use of vasoconstrictors, for discussion of the above solutions.*

Hyperbaric tetracaine is used as a total agent for all lower abdominal, obstetrical, and extremity surgery. As a general rule, it is not used for surgery above the T 10 area. Doses range from a maximum 7 mg. for appendectomy to 4 mg. for hemorrhoidectomy or vaginal obstetrical delivery. The anesthetic level achieved is dependent on the dosage of drug used and the length of time the patient remains in the sitting position. For appendectomy, the patient is placed in slight Trendelenburg position immediately after injection. For hemorrhoidectomy, the patient remains erect for 30 seconds and then is placed supine.

Hypobaric dibucaine is never used as a total agent. It is always combined with light general anesthesia. The intrathecal drug produces excellent muscle relaxation, a contracted bowel, and some analgesia. Small doses used produce spotty sensory anesthesia. Very light general anesthesia is used to decrease reflex irritability and complete the analgesia. Nitrous oxide-oxygen is frequently all that is necessary. It is to be again emphasized that very little general anesthesia is used—it is just sufficient to keep the patient asleep. With this technic, respiration can be assisted and the dangers of intercostal paralysis are minimized. Patients are invariably awake within five minutes after cessation of anesthesia. Doses of dibucaine vary from 2-4 mg., depending on the physical status of the patient. An average healthy male undergoing gastric resection would receive 4 mg. dibucaine, while sitting up, and would be kept erect for two minutes, then lowered to supine position. If this technic were elected for abdominal hysterectomy, 3-4 mg. would be used

*Annals of Surgery, February, 1948, page 338.

**RELATIONSHIP OF TYPE OF SURGERY TO CHOICE OF DRUG, DOSAGE, AND SITTING-UP TIME**

*(All anesthetics given in sitting position, lumbar area)*

| *Surgery* | *Dosage Drug Physical Status 1-2* | *Sitting Position Time* |
|---|---|---|
| 1. Cholecystectomy | 4 mg. Nupercaine | 2 minutes |
| 2. Gastric surgery | 4-5 mg. Nupercaine | 2 minutes |
| 3. Abdominal hysterectomy | 3-4 mg. Nupercaine | 1¼ minutes |
| 4. Miscellaneous lower abdominal surgery | 3-4 mg. Nupercaine | 1-1½ minutes |
| 5. Appendectomy | 7 mg. Pontocaine | 10 seconds—slight Trendelenburg |
| 6. Hernia | 6-7 mg. Pontocaine | 10 seconds—slight Trendelenburg |
| 7. Rectal surgery | 4 mg. Pontocaine | 30 seconds |
| 8. Obstetrics—vaginal delivery | 4 mg. Pontocaine | 30-45 seconds |
| 9. Cesarean section | 4-5 mg. Pontocaine | 10 seconds—slight Trendelenburg |
| 10. Lower extremities | 5-6 mg. Pontocaine | 10 seconds |

and the patient kept upright for 1½ minutes. It is our experience that this method of minimal-dose spinal anesthesia and very light general anesthesia produces operating conditions extremely difficult to equal with muscle relaxants and general anesthesia. The price paid by the patient in terms of physiological imbalance is least of any method. This method does have the disadvantage of requiring a somewhat longer time before surgery can be started as compared to general anesthesia and relaxants; however, the delay is rarely more than five minutes.

***d. Pencil-point lumbar puncture needle***

It has been suggested that a needle point which would separate the dural fibers would be less traumatizing than a needle which cuts or tears these fibers. Such a needle would probably also lessen postoperative leakage of spinal fluid and reduce incidence of postspinal headache. It was with this in mind that

we obtained 22-gauge needles* with solid ends drawn to a sharp point. The opening is in the *side* of the needle just proximal to the solid tip and is pinpoint in size.

The incidence of postspinal headache dropped over 100 percent following adoption of this needle and, in addition, another interesting point was noted. Because of the location of the opening, this needle is truly directional. Green states that with the ordinary beveled needle, it is impossible to obtain true directionality. With the needle we use, such is not the case. Solution is emitted from the orifice in a fine jet stream and it is believed that this may be a factor in obtaining relatively high levels of anesthesia with minimal volumes of drugs. Generally, the needle is introduced with opening cephalad; however, for anesthesia limited to the sacral area, it may be introduced with the opening caudad.

**e. *Ancillary procedures***

IV infusions are used with all spinal anesthetics regardless of procedure performed. Hypotension can be rapidly treated with small doses of ephedrine via IV route. Supplementary medication (barbiturates, etc.) can be administered should the need arise, without necessity for multiple venipunctures. Adequate hydration can also be a major factor in reduction of postspinal headache. Of course, when administration of blood is necessary, this infusion provides access to patient's circulation immediately.

Oxygen by mask is administered to all patients receiving total Pontocaine anesthesia. This serves several purposes:

1. It tends to counteract the stagnant anoxia common to spinal anesthesia.
2. It provides information visually, by movement of reservoir bag, as to adequacy of airway.
3. Should significant intercostal paralysis occur, respiration can be immediately assisted.

For the last 15 years at Huron Road Hospital, 35-40 percent of all anesthetics have been subarachnoid blocks, with a high of 42.6 percent reached in 1959.

A contributory factor to this high has been the increasing popularity of this method in obstetrics. In 1953, 12 percent of obstetrical cases received spinal anesthesia. In 1959, this figure surged upwards to 56 percent.

For further information regarding any phase of this report, please address inquries to:

Department of Anesthesiology
Huron Road Hospital
Cleveland 12, Ohio

*Pencil-point needles can be obtained from Becton, Dickinson and Co.

## Alarm Aids Heart Surgery

An instrument developed at Westminster Hospital, London, England, sounds an alarm at any irregularity

in the heart action of patients recovering from heart surgery. It is proving useful in postoperative care and is being used regularly in cases of "deep freeze" surgery.

The battery-operated instrument is portable and requires no attention once it is set up. It is connected to the electrodes which are normally inserted during heart operations. If the signals from these electrodes drop below a certain frequency, the alarm is set off. The instrument is usually left in place 18 hours after an operation.

The instrument has also been used during general anesthesia, and has behaved perfectly. Sudden cardiac arrest occurs from time to time even in minor surgery, and the alarm is useful in giving an early warning in such cases.

**Q. What percentage of all anesthesias given is administered by each of these groups: anesthesiologists, obstetricians, residents, and nurse anesthetists?**

A. Very little information has been published on who gives anesthesia. In 1955 the American Association of Nurse Anesthetists made a nationwide survey which found that during the month of January, 1955, the distribution of anesthesia administration was as follows: members of the American Association of Nurse Anesthetists, 34 percent; members of the American Society of Anesthesiologists, 18 percent; R.N.'s, 19 percent; M.D.'s, 27 percent; persons who were neither R.N.'s nor M.D.'s, 2 percent. In other words, 52 percent of all anesthetics were given by trained persons, and 48 percent were given by persons whose qualifications as anesthetists were unknown.

This questionnaire was sent to 7,032 hospital administrators in the United States, its territories, and possessions, and 3,235 returned it.

We know of no more recent national studies. However, we recently made a study of a state which had an average of 864 surgical operations and 453 births each day in 102 short-term general hospitals. In this state we found that there were 175 physicians principally administering anesthetics. Only 54 were board-certified. On the basis of hospital records and a detailed study of a sample of the 102 short-term general hospitals in this state, we concluded that anesthesia was administered to surgical and obstetrical patients according to the following distribution:

| | |
|---|---|
| Anesthesiologists (physicians) | 62 percent |
| Obstetricians | 9 percent |
| Residents | 4.7 percent |
| Nurse anesthetists | 24.3 percent |

Since this was a state with a relatively large population and a high number of surgical operations and births, there is perhaps a higher percentage of anesthetics administered by physicians. From my own observations I believe that these ratios will vary greatly from state to state.—*John G. Steinle,* writing in "Consultant's Corner."

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By Dorothy W. Errera, R.N.

### Anesthesia

Plano, Richard J.: "Tests Evaluate Fire Hazard of Static Sparks." *Modern Hospital,* 95:154, September 1960.

The hazard of static discharge in the operating room has been explored and conclusively identified; and attention has quite naturally progressed to considering the hazard of static discharge in the ordinary oxygen tent. One of the factors necessary to starting a fire is heat sufficient to heat flammable material above its flash point, and there must be a temperature high enough to keep the material above that flash point or the fire goes out. In this detailed study, it was found that a spark with 40 times the energy of any spark that might be produced in or near an oxygen tent did not ignite any of the following samples: plastic canopy material (vinyl), tissue paper, pure nylon, 100 percent wool, cotton muslin, and a dacron-cotton mixture. This meticulous study establishes that it is impossible to start a fire in an oxygen tent with a static spark.

Adams, Ralph; Trainor, James H.; and Corell, Robert: "Plastic Film Passes Tests for Surgical Use." *Modern Hospital,* 95:132, October 1960.

Transparent polyvinyl chloride film used in surgical drapes was found to be an excellent insulator when tested in the laboratory and in the operating room; a potential of two to three thousand volts was found on the loose edges of the film beyond that portion in contact with the patient. But when wet or tacky, the adhesive offers practically no resistance to conductive surfaces, and insignificant electric potentials were found where the plastic contacted the adhesive.

During manufacture a high potential of static electricity is built up on the drape, which is dissipated by the moisture of steam sterilization. But, as a result of steam sterilization, the drape sticks to the paper interfacing, and when these are separated at the time of use, there is enough friction to produce a high potential of static electricity.

This hazard is removed simply by wetting the drape or by having it contact a moist towel or drape.

The laboratory and clinical tests have convinced the investigators that in an operating room organized to meet the standards of grounding and conductivity outlined by the National Fire Portection Association, plastic (polyvinyl chloride) drapes are safe for use in the hazardous area.

Assisted by Dorothy W. Errera, R.N.

*Q. Is a sponge count necessary during abdominal surgery if all the sponges are removed from the field before the abdomen is opened and thereafter sponges are clamped to a forceps?*

A. Sponge counts are usually a matter of policy involving the surgeon, the operating-room staff, and hospital administration. An alert scrub nurse can easily control the traffic in sponges on the field, but success depends on a mature working environment in which there is mutual respect.

On the other hand, if the environment is one in which recriminations are common, a sponge count is necessary to allow everyone to remain detached and free of total responsibility.

*Q. Cultures of our anesthesia equipment show a heavy growth of Pseudomonas. The equipment is presently cleaned with pHisoHex. Should we change to 70 percent alcohol?*

A. Hexachlorophene, the active bactericide in pHisoHex, has no effect against gram-negative bacteria or the tubercle bacillus. Therefore, it is not a suitable detergent-germicide for disinfection of anesthesia equipment. Anesthesia equipment is terminally disinfected by immersion in an iodophor containing at least 75 ppm of iodine. It is scrubbed while submerged by a worker protected with gown, gloves, and mask. The lumen of tubes, small channels, and similar hard-to-clean areas must be mechanically scoured.

After cleaning, the instruments are submerged an additional 15 minutes to provide destruction of bacteria. Fresh solution is used because the initial solution usually is grossly contaminated with plugs of mucus and other material. At the end of the pro-

cedure, the instruments are rinsed thoroughly with tap water and hung up to dry.

If there are metal parts, a corrosion inhibitor should be added to the solution. Sodium nitrite, 2 grams per gallon of solution, is effective as a corrosion inhibitor for about 72 hours.

Because anesthesia equipment is so common to many patients, it should be sterilized daily in an ethylene-oxide sterilizer to prevent the accumulation of dangerous organisms. Routine disinfection terminally, as described here, suffices for use throughout the day between cases.

*Q. We are not sure how we should get rid of left-over ether. The anesthetist is inclined to pour it down the drain.*

A. If there are large quantities of ether to be disposed of, the local fire department will assume responsibility. If the quantities are small (pints or quarts), the containers are emptied somewhere outdoors. They should never be emptied down a drain. The hazards attached to this practice are legion.

The economical solution is to donate this ether to laboratory use.

*Q. Are there any specifications for overhead lights being explosion-proof?*

A. If the light can be lowered into the hazardous location, switches must be of explosion-proof design. Other specifications are outlined in detail in the *Code for Use of Flammable Anesthetics*, available from the National Fire Protection Association.

*Q. Can gas machines be left in the operating room at the end of the day?*

A. The NFPA bulletin mentioned above specifies that one machine and its accompanying tanks can be left in each room. Others are stored in the ventilated room provided for cylinder storage.

*Q. Are brass brads in a shoe heel satisfactory for making the shoe conductive?*

A. Shoes with ferrous nails in the heels are not acceptable for use in the operating room because there is always the possibility that a percussion spark may ignite a combustible mixture of anesthetic gases.

Aside from this disadvantage, the shoe with only a brad in the heel is unsatisfactory because minimal contact is made with the conductive floor.

Conductive footwear is available in a wide range of styles to suit need, taste and pocketbook. In making a final choice, one must consider the need for footwear which is hygienic and sanitized as well as conductive. Washable conductive shoe covers or conductive shoes that are amenable to laundering are but two possible choices to achieve a total safety picture.

*Q. What is your opinion on the use of ether to clean skin and remove tape postoperatively? I have heard that it is dangerous, but the surgeons still request it.*

A. There is one legitimate use for ether on human skin—that is for defatting before certain immunizations or allergy testing. Otherwise ether is an expensive, dangerous, toxic, irritating substance that has no place in patient care except as an anesthetic. Superior agents for removing adhesive tape are available. Furthermore, many patients state a preference for letting residues of adhesive wash away in the course of routine bathing.

*Q. A recent abstract in the O.R. bibliography section in* TOPICS *mentioned cellulose wadding contaminated with Pseudomonas. What was the source of organisms?*

A. The Pseudomonas is found everywhere—in soil and water. It probably came with the cotton used for the cellulose wadding, and because British cotton is not routinely bleached or soda-boiled, it persisted in the finished product.

*Q. Do you think that routine throat and hand cultures on employees in the operating room have enough value to justify the time consumed in obtaining them?*

A. Cultures of the nasopharynx, throat and skin identify carriers of epidemic strains of organisms. However, the bacterial reflection of hospital personnel is altered by many factors, including environmental exposure, personal hygiene, and the presence of respiratory or gastrointestinal disease, and routine cultures are only a panoramic index.

When cultures are in order, it is easier and more significant to culture the material which collects in gloves worn during an operation and to culture a mask after it has been worn for 30 minutes.

*Q. Would you recommend hiring a person with a recently done colostomy? Are there any chances of infection being spread?*

A. Properly cared for, a colostomy should be no greater hazard than the normal anus. Because of the extent of surface contamination and the likelihood of bacteria reaching the clothing, greater care must be taken whenever there is upper-respiratory infection or enteritis. Clean clothing daily, care of the skin with a soap containing hexachlorophene and TCC (trichlorcarbanilide), sanitization of the colostomy bag, and careful washing of the hands should make anyone with a colostomy safe for work in the aseptic area.

*Q. One of our operating-room staff nurses lives with a brother recently diagnosed as having viral hepatitis. Should this nurse be permitted to continue to work in the operating room? Some physicians here believe that she should be detached from the operating room for six weeks but should be allowed to work elsewhere in the hospital.*

A. The several kinds of viral hepatitis are spread in two distinctly different ways. The homologous serum jaundice variety is spread only by introducing blood, tissue fluid or pus from an infected patient to the victim. Infectious hepatitis is spread by the feces-urine route. Neither of these modes of spread pertains particularly to a nurse working in the operating room, where contact with patients is more ideally hygienic than anywhere else in the hospital.

If the doctors are in doubt concerning the diagnosis of infectious hepatitis to the point that they would permit your nurse to work elsewhere in the hospital, I do not believe there is any indication for removing her from work in the operating room.

*Q. Our policy committee recently ruled that postoperative patients with drains in place should not be admitted to the recovery room. It seems to us that there are patients who are greater spreaders of dangerous organisms who are routinely admitted for recovery-room care. We would appreciate help in defining a policy for this question.*

A. The ultimate decision as to the communicability of a patient with bacterial infection can only be made by the bacteriologist on the basis of cultures of the bedding and environment in which the infected patient is housed. Some patients with infection shed bacteria prodigiously; in others, bacteriologic control is a local problem.

Because of the intense activity and the confined, crowded and intensely-used facilities in the recovery room, general technic should be maintained at a high level of asepsis to prevent cross-infection. Under such circumstances, it should not be difficult to care for patients with infection without hazard to others. Recovery rooms should be equipped with a cubicle surrounded by an ultraviolet barrier to contain the bacteria in such a situation.

The decision as to whether the patient requires hospital recovery-room care should be dictated by his physiologic needs rather than by the fact that he has infection. Usually, infected patients' health is impaired; they require more insight for survival than ordinary elective cases. To abandon an infected patient under these circumstances to an inexperienced nursing unit is not in his best interests.

The presence or absence of a drain has little significance in arriving at the decision as to whether or not the patient is infected. Indeed, most patients are drained for reasons other than infection.

*Q. What do you think of an instrument table draped like a tent with the ultraviolet lamps attached to keep the instruments sterile?*

A. Ultraviolet barriers have been used to prevent fallout of organisms on sterile instruments. It is my conviction that this type of protection is superfluous in a hygienic operating room, where the fallout on instruments sterilized specifically for the individual case is inconsequential.

*Q. What is used for cleaning the shoe soles in the film, "Hospital Sepsis: A Communicable Disease"?*

A. The shoe cleaner is an ordinary polystyrene floor mat cut to fit a plain metal or enamel tray. A detergent-germicide solution is poured on the mat at regular intervals throughout the day. When it is grossly soiled, it is discarded and a fresh mat is put in place.

*Q. Our housekeeping department recently purchased an automatic floor-scrubber which is used to clean the corridors throughout the hospital. The machine meters out a hexachlorophene solution, scrubs the floor, and sucks the fluid up into the vacuum. The housekeeping department would like to use the same machine in the operating room and delivery suite. Do you think this suggestion is acceptable?*

A. Hexachlorophene agents are not necessarily the best choice for floor disinfection. The synthetic phenolics and quaternary ammonium compounds offer a wider range of bactericidal action to cope with the broad spectrum of bacteria common to floors.

The floor-scrubbing machine can be used throughout the hospital. Transient dirt picked up during the course of travel can be removed from the castors by running the machine through a puddle of germicidal solution. The brushes are cleaned and disinfected in the course of actual use.

*Q. Our hospital engineer objects to changing his clothes when he comes into the operating suite for a repair which does not involve his entering an operating room. We struggle to convince him that this is really a necessity and not just a whim of the nursing staff.*

A. His clothing is almost certain to become heavily seeded with clostridia as he goes from plumbing repairs to chores in the garden and grounds. Show him the way air currents or changes in ventilation can carry the bacteria in lint and dust shed from his clothing in the corridor into the operating room where a radical mastectomy or mid-thigh amputation is being done. The vapor trail from a titanium bomb or a piece of dry ice dropped in a glass of warm water is usually convincing evidence that air is a wonderful vehicle for transporting bacteria.

*Q. How do you suggest handling linen from a case in which the gas bacillus has been a contaminant?*

A. Linen is gathered by the scrub nurse in an *intact* laundry bag. Care is taken to assure that damp pieces are wrapped deep in bundles of dry pieces, so that there will be no seepage.

The bag should go directly to the laundry for fairly prompt treatment. The contents and bag are dumped directly into the wash wheel. The usual wash cycle with water at 180° F. is adequate for disinfection.

If a commercial laundry must be relied upon, and consequently there is no direct control of laundering technics and pick-up may be delayed, the bag

and contents should be exposed to saturated steam at 250° F. for 30 minutes.

The hazard of disease transmission is in letting blood and pus in linens and dressings dry. Spores are then freed into the environment with motion and activity.

The usual technic of cleaning after any surgical case is adequate for this instance, provided it includes: prompt terminal sterilization in heat of contaminated instruments and heat-stable equipment; disposal of non-heat-stable articles; careful collection and efficient laundering of linens; bagging of soiled sponges in waterproof containers for incineration, and good technics of floor disinfection. Walls need no more than routine housekeeping unless there is evidence of gross soiling. Finally, the room is *not* quarantined.

*Q. What can be used as a litter barrier other than a floor-recessed sponge? We are afraid that solution tracked over the floors will make them slippery.*

A. A litter barrier is a useful device when litters come from the ward and enter the operating room. A barrier at the entrance of the operating room is effective if it is long enough to insure a complete revolution of the largest wheel. Many hospitals have a dry pad inside the corridor to remove excess germicide. Others soon discover there is so little germicide carried on the tires that the slip hazard does not exist.

*Q. Do you think there is a trend toward considering all surgery as dirty?*

A. A standard technic for cleaning up after all surgery is practical and desirable for many reasons. For one, the virus of homologous serum jaundice is always a potential contaminant, and terminal heat sterilization of contaminated instruments is mandatory to eliminate the hazard of transmission. Questions of infectivity and resistance in the staphylococcal infection problem remain unresolved. The apparently-healthy patient may be a carrier and a serious threat to other patients (and personnel) whose patterns of resistance differ. Controlled disposal and treatment of contaminated supplies contribute to over-all control of spread of infection.

The major elements of any surgical case are identical and amenable to a standard technic. Hence, all instruments are as easily discarded directly into a sterilizer; all linen is promptly bagged; unused supplies are collected in an orderly fashion for return to the supply room and terminal sterilization.

*Q. Should there be any preference in scheduling an eye case over a tonsillectomy?*

A. Cataract operations should be scheduled for the quietest time of day when there will be the least possible dust in the air. The problem is one of foreign-body control to prevent opacities from foreign bodies, rather than infection control.

*Q. As part of our instructions in caring for a patient with gas gangrene, we are advised to "fractionally sterilize" soiled linen before sending it to the laundry. None of us is familiar with the technic and would appreciate an explanation.*

A. In 1876, John Tyndall, an English physicist, described a method for sterilizing solutions containing heat-resistant bacteria. These were heated to the boiling point five times. Between each heating, the solutions were held at room temperature for 10 to 12 hours. In theory, resistant bacterial spores that survived exposure to boiling were to change into heat-sensitive vegetative organisms during the incubation periods. Free-flowing steam from boiling water was used because equipment for steam sterilization was not available. The method became known as Tyndallization, or fractional sterilization.

You are being advised to expose linen to flowing steam (from what source I do not know) for 20 minutes on three separate occasions—allowing the load to rest between heat treatments for 10 to 12 hours. Thus, you are advised to accumulate heavily contaminated material for days on end and to rely on a questionable process to make it safe for disposal to regular treatment.

Tyndallization (fractional sterilization) is at best an erratic process, because spores will develop into vegetative organisms during the incubation period only if proper nutrients are present at the correct pH, with proper oxygen tension, and if there are no bacteriostatic substances present.

The technic has no more place in modern hospital practice than the historic carbolic spray. Fractional sterilization of dry goods, even if possible, would have to be done at 14-day intervals with the linen immersed in nutrient broth, because once spores are subjected to a sublethal dose of heat, it may take 12 to 14 days for vegetation to occur in ideal culture media.

The most resistant dry spore is destroyed by 13 minutes exposure to saturated steam at 250° F.—the microbicidal temperature achieved in the modern sterilizer. As steam penetrates a package or a bag of linen, it condenses, providing the moisture essential for sterilization, and the energy (heat) released by the change of state heats the package. The exchange of energy and concomitant condensation continue in the textile until the latter is heated to the temperature of the steam.

Heating spreads centripetally—that is, toward the center of a bundle or a package. Sterilization is achieved only if sufficient moisture has been deposited and sufficient energy liberated to heat all the material to 250° F.

If heating is not continuous (as in ordinary sterilizing practices), the outer wet shell of moist fabric cools between heating periods, and when next placed

in the sterilizer, it must be reheated. This may take longer than the original heating cycle, and the inner layers or center may not be heated to sterilizing temperature. Even if fractional sterilization were practical for this purpose, it is unsatisfactory because there is no mechanism for accurately measuring exposure and penetration.

The hysteria among personnel prompted by a case of gas gangrene is unrealistic. The *Cl. welchii* responsible for gas gangrene is a gram-positive, spore-forming anaerobe found in dust, soil, sewage, water, fish, mollusks, milk, cheese, and the feces of man, domestic animals, and birds. The spores are widely distributed throughout nature and can often be cultured from air, dust, and equipment in a hospital.

Cross-infection with the organism occurs by the fomites route. Trauma, a lowered oxygen tension in a wound to allow spores to germinate, impaired blood supply, necrotic tissue, a foreign body, gross soil, and dirt are the components necessary for wound infection with the clostridia.

Good surgical technic with accurate hemostasis, careful wound debridement, consistently precise sterilizing practices, and sanitary housekeeping control the hazard of cross-infection.

What actually is the situation in the operating room, for instance, in which a wound is being excised?

It can be correctly assumed that organisms will be present on instruments, linen, and sponges, in blood and body exudates. In the vegetative form, the clostridia are easily destroyed by heat and chemicals. As spores, they are more resistant and are unaffected by sunlight, air or boiling.

The resistance pattern of the spores gives a clue to the efficacy of routine sterilizing technics. The spores in their dry state can withstand exposure to 176° F. for one hour and resist destruction by boiling up to 70 minutes. But, all spores are killed by exposure to dry heat at 320° F. for one hour or exposure to steam at 250° F. for 13 minutes.

Therefore, obviously adequate is the routine of disassembling a room after surgery, in which instruments and heat-stable articles such as gloves, suction tubing, catheters, and suction bottles are promptly terminally sterilized in steam at 250° F. for 30 minutes. In the cleanup technic, all linen (including gowns, scrub suits, and dresses which have become wet with solutions from the field) is bagged in the room, with wet surfaces rolled toward the center to avoid wetting the laundry bag.

Spots of blood or pus on the floor and furniture are treated as soon as they occur with a slurry of calcium hypochlorite and tap water. Terminally, the floor and potentially contaminated surfaces of furniture, such as footstools, table bases, and shelves on which contaminated instruments have rested, are disinfected with a germicidal detergent.

Walls are not treated unless there has been gross soiling with poorly controlled suction or by a carelessly discarded sponge. Similarly, sterile supplies on open shelves at the periphery of the room need not be discarded or resterilized. The bacterial image on these is that of the room's normal population, and it is conceivable that some part of the pattern is already made up of clostridia.

Consideration of the characteristics of bacteria and the mechanism of survival and transfer emphasizes the absurdity of "quarantining" a room after gas gangrene has been treated. Blind conformity to this antiquated ritual creates the ideal situation for perpetuating the hazard; organisms easily destroyed in their vegetative state or when moist escape destruction by planned neglect. No amount of airing or sunlight will dilute the hazard of spores which take up residence in dust and dirt, awaiting the next surgical situation in which optimal conditions for growth may be present.

To return to the original question of care of contaminated linen: soaking soiled linen in disinfectants should be categorically discouraged. Splashing and spillage are impossible to avoid. Handling the linen frees enormous numbers of bacteria into the air. The action of many germicides is erratic, influenced by factors of protein soil, solubility, and water supply. Germicides should not be relied upon where more certain measures of destruction are practical.

With good equipment and intelligent management, laundering is a sanitizing process. Minimal standards call for water at 180° F. and exposure ranging to 50 or 60 minutes. Wash formulae include the use of alkalinizing and chlorine agents, both of which contribute to the bactericidal action of the wash water. Many modern laundry machines are equipped with steam injectors which make exposure of a load to boiling water simple and practical.

In communities where commercial laundries serve hospitals, investigation of the wash process should be undertaken by a member of the hospital staff. Education of the laundry manager and key personnel will usually elicit cooperation in rendering hospital linens safe for re-use.

If there is no escape from terminal heat sterilization of soiled linen, great care must be taken when loading the sterilizer to avoid contaminating the environment. Also, because waterproof laundry bags are common, access for steam must be guaranteed by loosening bag openings before sterilization.

*Q. Do you approve of suction lines coming into the field from overhead? The reason given is that this system removes the tubing from the floor.*

A. Overhead suction is a distinct hazard. The horizontal run of tubing is never sterilized, and the accumulations of contaminated material drool back into the wounds forever.

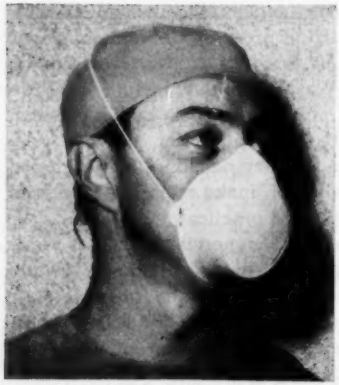

Fig. 1: Surgical Mask No. 540.

# Experience with a New Surgical Mask

By M. M. Musselman, M.D., H. W. McFadden, Jr., M.D., M. R. Cosand, M.D., and J. W. Porter, M.D.*

A good surgical mask must effectively filter bacteria. Yet, most surgical masks in use today filter out less than 10 percent of the bacteria after being used for 30 minutes. Fortunately, more people are becoming aware that a false sense of security results from reliance on these masks. The development of a surgical mask that can effectively filter bacteria has received renewed interest.

In 1897 Johann von Mikulicz Radecki[1] described a surgical mask composed of one layer of gauze. Fleugge[2] in 1897 demonstrated the danger of infection from bacteria-laden droplets sprayed from the nose and mouth during speech. Huebner[3] in 1893 and Lord Moynihan[4] in 1906 recommended the use of masks during operations.

Huebner recommended that masks be made of two layers of gauze and that they be worn at a distance from the nose. He showed that gauze masks worn close to the nose collected moisture which reduced the efficiency of the mask. The efficiency of masks was improved by increasing the layers of gauze and making the mesh finer. Around 1920 some [7-10] recommended that masks should contain five to six

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layers of gauze, with a mesh of at least 44 x 40 threads per square inch.

By the late 1920's the use of surgical masks was widespread. Starting in the 1930's deflector-type masks were introduced [10-15]. Some authors [16-17] criticized deflector masks because they only deflected bacteria and air pollution was essentially the same as if no masks were worn. In 1958 Kiser and Hitchcock[19] developed an effective mask combining the deflection and filtration principles. Adams *et al*[20] developed a mask with high filtration efficiency that could be sterilized, and used repeatedly.

An ideal surgical mask, according to Rooks [22] and Wulff[23], should:

1. EFFECTIVELY FILTER BACTERIA
2. Leak no air
3. Not hamper breathing
4. Be comfortable
5. Be compact.

While evaluating new types of surgical masks, we have found one that is effective and wearable; that is, it has an effective filter, it fits the face snugly, and it is breathable, comfortable and compact. Because it is made to be used only once, use of this mask saves the time and effort usually spent laundering and handling masks. Throughout the rest of this report we will refer to this mask as Surgical Mask #540** (Figure 1).

**Developed by Minnesota Mining and Manufacturing Co., St. Paul, Minn.

### Procedure

Surgical Mask #540 has a highly efficient filter incorporated in a plastic shell that is shaped to fit the face and has an elastic band to hold it to the face. We have tested this mask for efficiency in filtering bacteria and for wearability.

We started out testing the efficiency of various masks for filtering out bacteria, using human subjects and agar plates. Like others [9,16,20,21,28] we found the results unreliable and unreproducible. We have since adopted a mechanical test modified from methods described by Allen[25], Guyton and Lense[26], and Wilson and Harrod[27]. This test measured the efficiency of a material for filtering out bacteria by forcing through it a stream of air containing an aerosol of bacteria. This was done in a closed system.

Figure 2 shows diagrammatically the system we used. The air supply was filtered and regulated by a flowmeter at 10 liters per minute. The air flow activated a nebulizer containing 5 ml. of a dilute culture of *Serratia marcescens*. Thus an aerosol of bacteria was directed into the main air stream. The air stream passed through the material to be tested and then through a Millipore† membrane filter. At the end of two minutes, the air valve was closed and the membrane filter was removed and placed in a petri dish containing a nutrient agar. After incubation at 37°C.

†Produced by Millipore Filter Corp., Bedford, Mass.

tor 48 hours, bacterial counts were determined. Efficiency was expressed as:

$$\% \text{ Efficiency} = \frac{\text{(Control Counts) - (Test Counts)}}{\text{(Control Counts)}}$$

The test then was repeated for 30 minutes simulating clinical use over a period of time. Pressure drop across the test material also was measured to evaluate "breathability."

Using this method, we tested gauze masks taken at random from the operating room. Some had been laundered several times and some were new. Also, we tested the filter of Surgical Mask #540.

A sneeze test was done to show the efficiency of the gauze mask and Surgical Mask #540. Photographs were taken using stroboscopic light and a fast shutter speed. Photographs also were taken of the filter material with a constant light source. The photographs then were enlarged 25 times to show more detail of the filter material.

During the past year Surgical Mask #540 has been tested in use. Staff surgeons, residents, interns, medical students, nurses and student nurses have worn the mask in the operating room. They completed a report on each mask worn, evaluating fit, comfort, "breathability," warmth, air leak, visibility and "speakability." More than 1,000 masks were tested. Design and composition of the mask were modified according to the suggestions received from the reports.

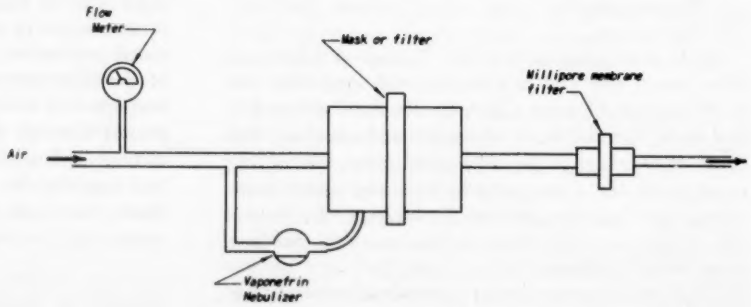


Fig. 2: Mechanical filter test.

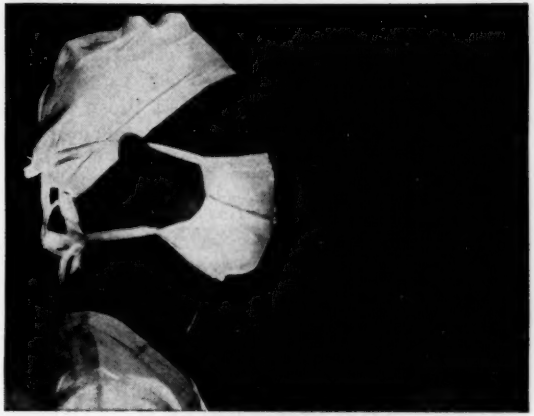

Fig. 3: Sneeze with gauze mask.

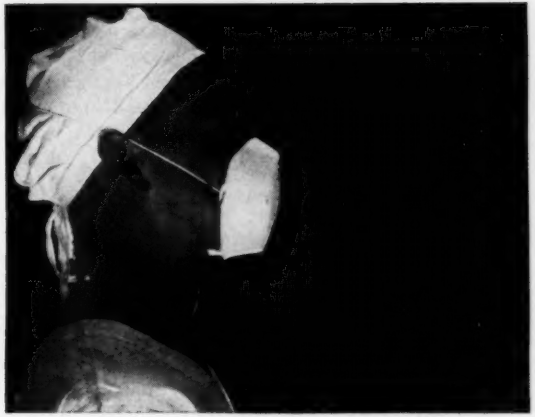

Fig. 4: Sneeze with Surgical Mask No. 540.

### Results

The results of our tests for efficiency of bacterial filtration of the ordinary gauze mask and of the filter of Surgical Mask #540 are shown in Table 1. The efficiency of the gauze mask was relatively poor—40 percent when tested for two minutes. Furthermore, when the test was continued for 30 minutes, the efficiency fell to less than 10 percent. On the other hand, the filter of Surgical Mask #540 had an efficiency of 86 percent after a two-minute test, and it showed no reduction in efficiency after 30 minutes. This suggested that the efficiency of filtration of Surgical Mask #540 would remain high with use over a period of time.

The results obtained by an independent group[24] were similar to ours, as Table 2 shows. The results of the sneeze test are shown in Figures 3 and 4. These photographs need little description. The inefficiency of the gauze mask is obvious. No droplets were seen on the sneeze test with Surgical Mask #540.

**Table 1. Mechanical Testing at the University of Nebraska College of Medicine Comparing Percent Efficiency of Surgical Mask #540 and Gauze Masks**

| | 2 minutes | 30 minutes |
|---|---|---|
| Surgical Mask #540 (25 tests) | 86% | 90% |
| Gauze Mask (7 tests) | 40% | 10% |

**Table 2. Mechanical Testing by Independent Group[24] Comparing Percent Efficiency of Surgical Mask #540 and Gauze Masks**

| | 5 minutes | 30 minutes |
|---|---|---|
| Surgical Mask #540 (10 tests) | 90% | 90% |
| Gauze Masks (10 tests) | 30% | 8% |

Photographs of the filter material both magnified the same number of times are shown in Figures 5 and 6. No open spaces are present in the filter of Surgical Mask #540. However, many open spaces are present in the gauze filter material.

In clinical use Surgical Mask #540 fit snugly. It must be adjusted on the face until it is comfortable and leaks no air. The elastic band should not touch the ears. After making these adjustments most persons found the mask comfortable and had no difficulty with fogging of their eyeglasses.

Anything new usually requires adjustments. We suggest that each person wear this mask three or four times to become accustomed to it. Then a person can satisfactorily judge this mask based on the criteria for the ideal surgical mask. Most wearers during our tests were not conscious of having it on during an operation.

### *Discussion*

We realize there are many factors in the prevention of sepsis. One of these is an effective surgical mask. Since 1920 there has not been a widespread improvement in surgical masking. Since that time the standard surgical gauze mask has been widely used. Our tests and the tests of others show that gauze masks provide poor protection for the patient and generate a false sense of security.

Better masks are being developed and tests for their efficiency are being improved. We should take advantage of these improvements now.

Surgical Mask #540 meets the major criteria for an adequate surgical mask. It has excellent efficiency for bacterial filtration, showing 86 to 90 percent efficiency in tests lasting from two to 30 minutes. The filter of the mask is held away from the nose and mouth and thereby prevents reduced efficiency of the filter from wetting.

Our staff found the mask light and comfortable in use. Although a few complained of excess warmth and difficulty in breathing, we believe this slight dis-

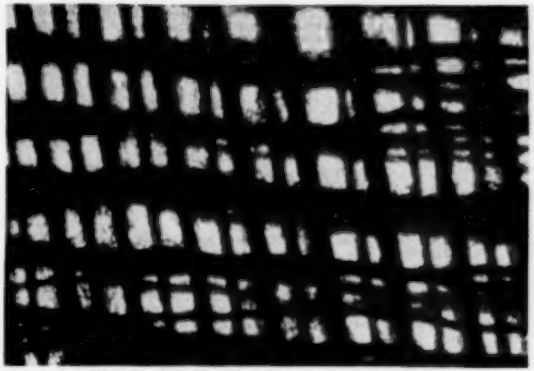

Fig. 5: Magnification of gauze mask filter.

Fig. 6: Magnification of Surgical Mask No. 540 filter.

comfort a small price to pay for excellent protection for the patient. The fit of the mask was excellent, allowing very little leak from the edges. We had few complaints from surgeons of their glasses fogging while using these masks, and we have had no difficulty in speaking to one another while wearing the masks. We have found this a problem with some of the other new masks.

The mask did not obscure the vision of the wearer. Finally, because it was used only once and discarded, its use eliminated the washing, handling and sterilization necessary with gauze masks.


### *Summary*

We have tested a new surgical mask and found it efficient and practical. Surgical Mask # 540 filters out bacteria efficiently, fits comfortably, and is light and compact. It does not leak air from the edges and does not interfere with vision or speech.



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# Effective Infection Control Program Must Be Cooperative Venture

By Elaine D. Dyer, R.N., M.S.*

The presence of staphylococcal infections as a postoperative complication of surgical patients in our hospital pointed up the need to evaluate the policies and procedures for total care of the operated patient. Evaluation would involve many problems and services, but the best place to begin seemed to be in our own department, the operating room.

We made an intensive investigation of the literature so that we might profit from the experiences of other hospitals. A comparison of our technics with those suggested in the literature indicated that we had kept current in most areas but that some of our technics and procedures should be re-evaluated. Our physical setup made the adoption of some suggestions difficult.

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The areas that appeared to require revision fell into three categories:

(1) Housekeeping procedures.

(2) "Green line" rules. The green line is an imaginary line that divides the inner area from the interchange area. Personnel must be attired in operating-room clothing, usually green, to enter the inner area of the operating-room suite. They may not leave the interchange area and enter the ward area without changing to street or white clothing.

(3) Standardization of procedures.

A working committee consisting of the chief of surgical service, the chief of anesthesiology, and the operating-room supervisor studied the problems related to the control of bacteria in the operating-room environment and the operative field. People who would be affected by indicated changes participated

in developing the new procedures. The following questionable conditions were found and the following corrective measures were taken:

### *Housekeeping Procedures*

Procedures developed from principles through democratic means usually gain the support of thinking people. When the correct way to complete a procedure is the convenient way, little supervision is necessary. Nurses and nursing assistants attempted to make the procedure correct and convenient (see Table 1).

Nursing assistants participated in the development of the regular and septic case cleaning procedures. In the beginning they were reluctant to consider the changes in the cleanup procedures, but they were impressed by printed reports and discussions of the relative merits and safety of the different procedures. Bacterial counts of the floor using two methods and a study to determine the number of air-borne bacteria present while the wet-pickup vacuum was in use helped to convince them that the new procedures made the operating room safer for the patient.

To evaluate the effectiveness of two different floor-cleaning procedures, we cultured floor areas. The doors to the rooms were closed. Only two people were in the room. Both were masked. Three-inch squares were drawn on the floor on each side of the room where traffic is usually heavy. One square was used as a control. A culture was made before the test cleaning. Then the disinfectant and cleaning solution was applied with a spray. The solution remained in place for five minutes and was removed with a freshly laundered damp cotton mop.

The wet-pickup vacuum technic was then used to clean the other side of the room. Again the solution was applied with a spray. After five minutes, it was removed with a wet-pickup vacuum.

Cultures were taken from the cleaned squares in the following manner: a sterile applicator was moistened with sterile water, and then rubbed over the entire surface of the square; the contaminated applicator was then used to streak a blood agar plate. This process was repeated for each square.

It appears that the wet-vacuum procedure is a more effective cleaning and disinfecting technic for floors. However, these tests should be continued for a longer period of time before we make any significant predictions.

**Cotton Mop Technic**

| | No. of Colonies | Type of Colony |
|---|---|---|
| Sq. 1 | 30 | Hemolytic and nonhemolytic *Staph. albus* coagulase-negative |
| Sq. 2 | 10 | Same as above |
| Sq. 3 | 17 | Same as above |

Table 1

## Housekeeping Procedures

| Conditions Considered | Changes Instituted |
|---|---|
| 1. Regular cleaning procedure<br>a. Cotton mop heads used to clean floors prior to surgery and between operations and at completion of surgical schedule. Disinfectant solution used for mopping.<br>b. Cellulose hand sponges used to clean lights, furniture, and equipment prior to surgery (Amphyl or Staphene used to moisten sponge). | 1. a. Cotton mops and mop buckets discarded. Spray tanks, cellulose mop heads, and wet-pickup vacuum purchased. (Cellulose mop heads can be disassembled and sterilized in the autoclave. A fresh mop per room per day is used. Each mop is autoclaved at the end of the schedule in the room or after use in a contaminated case, whichever occurs first.) Cellulose mop heads are used to clean the floor prior to surgery and between operations. After the completion of the schedule, the floors are cleaned as follows:<br>(1) Spray tanks are used to apply disinfectant and cleaning solution to the floor. Solution is left on the floor for five to 10 minutes.<br>(2) Wet-pickup vacuum is used to remove the solution. |
| 2. Septic case cleaning procedure (separate equipment used to clean after septic cases)<br>a. Cotton mop heads used to apply and remove cleaning and disinfecting solutions. Disinfectant-soaked cellulose sponge used to apply disinfecting solution to the equipment and walls.<br>b. Walls and equipment wiped with a clean dry rag after 10 to 15 minutes contact with disinfectant.<br>c. Caps, masks, and gowns left in room. Shoes wiped off on disinfectant-soaked towel. | 2. a. Spray used to apply disinfectant solution to walls, equipment, and floor.<br>b. After 10-minute contact period the solution is removed from the walls with a squeegee, from the equipment with a cellulose sponge, and from the floor with the wet-pickup vacuum. (The vacuum is not taken into the room. The solution is squeegeed toward a door, and the pickup is made by an assistant operating the machine from the hall.)<br>c. Caps, masks, gowns, and shoes left in room for processing. Caps, masks, and gowns are bagged and sent to the laundry. Shoes are autoclaved. |

**Wet-Vacuum Technic**

| | No. of Colonies | Type of Colony |
|---|---|---|
| Sq. 1 | 1 | Nonhemolytic *Staph. albus* |
| Sq. 2 | 1 | Same as above |
| Sq. 3 | 1 | Same as above |
| **Control** | 8 | Nonhemolytic *Staph. albus* coagulase-negative |

The experiment to determine the numbers of bacteria in the air during operation of the wet-pickup vacuum was performed in an operating room at the end of the schedule, after the room had been emptied of furniture and the floor had been sprayed with a cleaning and disinfecting solution. The doors were closed.

Three members of the operating-room staff wearing masks helped with the test. Three blood-agar plates were exposed simultaneously for a five-minute period. One plate was opened and placed on a table that had been brought into the room; one plate was opened and held 6″ to 8″ from the air-conditioner ventilator; and one plate was opened and held in the air stream exhausted from the vacuum. This test was repeated on four successive days.

Our results showed no increase in the number of bacteria expelled into the air through the vacuum exhaust. We realize, of course, that this test also needs to be continued for a longer period before we can make any significant conclusions.

Two types of wet-pickup vacuums were demonstrated and left for trial periods. The aides used them and helped to decide which machine we should purchase. The features that influenced our decision were: (1) easier maneuverability for our method of cleaning; (2) greater motor horsepower and strength of suction, and (3) venting of the exhausted air from the top of the machine, so that floor dust was not disturbed.

### *Green Line Control*

The green line must be observed if "house" bacteria are to be kept out of the inner area in the operating-room suite—the area which contains all the operating rooms, sterilizing equipment, sterile storage, and equipment needed for surgical procedures. All personnel must abide by the rules.

Control measures were studied at informal meetings of the chief of surgical service, the chief of anesthesiology service, and the operating-room supervisor. They suggested the changes which are shown in Table 2.

### *Standardization of Procedures*

If a service can develop a standard procedure that is understood by everyone, chances are multiplied that the procedure will be completed correctly.

Table 2

## Green Line Control

| Conditions Considered | Changes Instituted |
|---|---|
| 1. Scrub clothes<br>a. Personnel were not always observing the green line. Some green clothes were being worn to the wards. Those following this practice stated they changed before re-entering the inner area. | 1. a. No green clothes are worn outside of the operating-room suite unless an emergency occurs.<br>b. A physician in white is called to accompany the patient from the interchange area to the recovery room. |
| 2. Shoes<br>a. O.R. shoes were being worn by personnel when they entered the inner area, but they were not being cleaned routinely by the owners. | 2. a. New conductive-soled shoes were purchased for all personnel. The shoes are all rubber with an inner layer of cotton fabric. After each wearing, they are scrubbed with soap and water, rinsed in a 1% Amphyl or Staphene solution, air-dried, paired, and put on the shoe rack for use. These shoes can be autoclaved, but it seems to shorten their life. At present shoes are autoclaved only after contaminated cases. |
| 3. Patients' dress in O.R.<br>a. Patients brought to O.R. covered only with an O.R. sheet.<br>b. Pajama trousers left on some patients receiving local anesthesia.<br>c. Caps and masks worn by patients in the O.R. | 3. a. No change.<br>b. No patients' clothing is allowed in the inner area. Patients are attired in green scrub suits whenever necessary.<br>c. No change. |
| 4. Personnel with infections<br>a. Personnel with infections checked by the chief of surgical service or designate before being admitted to the inner area.<br>b. Personnel with colds not allowed to scrub. If possible they were given duties that do not require them to enter the inner area. | 4. a. Continued as before. All personnel observe for infections, which prevent personnel or patients from entering the inner area of the operating suite.<br>b. Cultures are made of infections to determine the organisms involved. |
| 5. Patients with infections<br>a. Patients with infections are treated as septic cases.<br>b. Patients with infections are not admitted to the recovery room. | 5. a. No change.<br>b. No change. |

Table 3

## Standardization of Procedures

| Conditions Considered | Changes Instituted |
|---|---|
| 1. Preparation of patient's skin<br>a. Several different solutions used after the shave:<br>(1) Septisol, Ethanol 70%, and tr. Merthiolate.<br>(2) Septisol, water, and aqueous Zephiran 1:1000.<br>(3) Septisol, alcohol 70%, and tr. iodine 2%.<br>(4) Septisol, alcohol 70%, and tr. Zephiran 1:1000.<br>(5) pHisoHex, saline, and aqueous Zephiran. | 1. a. Regular preparations standardized to:<br>(1) Septisol, Ethanol 70%, and tr. Zephiran.<br>b. Face and mucous membrane preparation standardized to:<br>(1) Septisol, saline, and aqueous Zephiran 1:1000. |
| 2. Scrub technic, hands and arms<br>a. Several technics used:<br>(1) 5-minute brush scrub with pHisoHex followed by a water rinse.<br>(2) 10-minute brush scrub with Septisol followed by a 1-minute soak in Ethanol 70%.<br>(3) 10-minute brush scrub with bar soap followed by 1-minute soak in Ethanol 70%. | 2. a. Major case scrub standardized to:<br>(1) 7-minute brush scrub with Septisol.<br>(2) Drying with a sterile towel.<br>(3) 1-minute friction soak in Ethanol 95%.<br>(4) 3-minute friction soak in Ethanol 70%.<br>b. Minor case scrub: same as above except that a 3-minute brush scrub is used. |

The chief of surgical service assumed leadership for reviewing the technics for preparation of the patient's skin and for scrubbing the skin of the team's hands. All interested members of the medical and nursing staff were involved. The final procedures were approved in surgical staff meeting (see Table 3).

### Perpetuating the Program

Any procedure or policy, if it is to continue to be effective, must be written, understood, and reviewed periodically. At our regular conferences, questions are discussed. When necessary, committees are appointed to investigate and resolve the problems.

Control of resistant staphylococcal infections must be a cooperative venture. It takes the combined efforts of all departments which deal directly with patients. The people involved in indicated changes must understand the program, so that they can work intelligently and cooperatively with one another. It appears that more permanent changes can be effected through group-involved research projects.

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*(Abstract of a paper from the 1961 clinical congress of the American College of Surgeons)*

## Staph Carriers Common Among Personnel, But Infrequent Cause of Infection

In an effort to determine the relationship of operating-room carriers of *Staphylococcus aureus* to the incidence of wound infections, bacteriophage typing was carried out on all coagulase-positive strains of *Staphylococcus aureus* from nasal cultures on patients and on all persons entering the operating room during 213 clean operations.

During 139 operations (65 percent) one or more staphylococcal carriers were present, but none of the patients developed infections. In one of these operations, nine of 13 persons in the room were carriers. In 63 operations (30 percent) there were no carriers and no infections.

Infections developed after 11 operations (five percent). During 10 of these, carriers (patient, personnel, or both) were present. Of the two infections that could be related to carriers, one was caused by a strain also carried by two surgeons, and the other by a strain also carried by the patient.

Phage typing of concurrent cultures of the air, floor, and wash water during operation, and in some instances of gloves and the patient's blood, failed to reveal a potential source other than people for any of the infections.

Carriers of *Staph. aureus* among operating-room personnel are frequent, but the development of wound infection caused by carrier strains is infrequent, we have concluded on the basis of our findings. Exposure to a source is but one determinant of infection. The more important factors probably lie in the host and in the virulence of the organism.—*David D. B. Woo, M.B., Thomas F. Silva, Jr., M.D., Alice T. Marston, Ph.D.,* and *Chester W. Howe, M.D.,* department of surgery, Massachusetts Memorial Hospitals, and the departments of surgery and microbiology, Boston University School of Medicine.

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By Dorothy W. Errera, R.N.

### Infections and Their Control

Sussman, M., and Stevens, J.: "*Pseudomonas pyocyanea* Wound Infection—an Outbreak in an Orthopedic Unit." *Lancet* 2:734, October 1, 1960.

A patient with compound fractures of the tibia and fibula, multiple head injuries, and chest injuries was admitted to the emergency room. Tracheostomy was done in the "plaster room." The patient developed tracheobronchitis, and a swab of bronchial secretions five days later produced *Pseudomonas pyocyanea, Staphylococcus aureus,* and beta-hemolytic streptococci.

Six days later, three more fracture cases had wound infections from which the *Pseudomonas pyocyanea* was isolated. Three of the four patients infected were males; one was a female. It was logically thought that the plaster room was the common denominator because cultures of dust, curtains, blankets, and air were negative in the two wards involved. It was concluded that probably the first patient had sprayed organisms from his tracheostomy while he was in the room and culturing had begun.

The ancient plaster bucket grew out masses of the organisms, and it was promptly replaced. However, four more cases occurred in rapid succession; so the old bucket may have been a contributing cause but apparently was not the major source of organisms.

Powdered plaster of Paris and ready-made bandages were used. Cultures of these were negative, but the cellulose wadding ("wood wool") used for padding produced large numbers of organisms.

Apparently the moisture provided when the wet plaster bandage was placed on the contaminated padding supplied the means for migration of bacteria to the wound.

The Esmarch bandage in the room was also heavily contaminated with *Cl. welchii, Staphylococcus aureus, Staphylococcus albus,* coliforms, and aerobic spore-forming bacilli. The cellulose wadding and the Esmarch withstand exposure to saturated steam at 250° F. for 30 minutes without appreciable deterioration, and the authors emphasize the necessity for sterilization of all dressing materials, no matter how remote their association to the wound may be.

Nahmias, Andre J., Godwin, John T., Updyke, Elaine L., and Hopkins, William A.: "Postsurgical Staphylo-

coccic Infection—Outbreak Traced to an Individual Carrying Phage Strains 80/81 and 80/81 52/52A." *J.A.M.A.* 174: 1269, November 5, 1960.

In a 300-bed hospital doing 600 surgical cases a month, an increase of infections inspired a review of bacteriological records. From January to July one to three cases were reported per month; from August to October, the number jumped to six to seven infections per month. When 100 staff physicians were queried, it was found that 25 of 94 wound infections were first seen in the physicians' offices after the patients had been discharged from the hospital.

The sleuthing went on. Environmental factors were ruled out, as were instruments, special equipment and so forth. This left people—and especially the people on one surgical team—associated with 13 infections.

One surgeon was common to all 13 patients infected. Prior to his transfer to the service, there had been one infection in the preceding three months. In the first three months of his affiliation with the service, 13 infections occurred. A little more investigating turned up the fact that he could be identified with four infections which occurred in patients on his previous service. Antibiograms were similar in two of these four and the infections on his current assignment, the thoracic service. Cultures indicated this surgeon as the carrier of the infecting strains. He was spreading organisms from his nose, face, and hands.

A thorough physical examination was completely negative.

He was sent on a three-week vacation with prescriptions for a nasal antibiotic ointment (bacitracin and neomycin) and oral chloramphenicol to be taken for one week. Cultures taken when he returned were positive for only coagulase-negative staphylococci. There were no infections associated with his team while he was away and none after his return. (In the seven months following he remained innocent as a carrier.)

The physician was a completely asymptomatic carrier who spread his organisms to 13 patients, all of whom were receiving prophylactic antibiotics. The length of exposure to contamination is as important a factor as that of the host's natural resistance. In all patients who developed infections, the operative procedure had been well over an hour in duration.

White, Arthur: "Relation Between Quantitative Nasal Cultures and Dissemination of Staphylococci." *J. Lab. and Clin Med.* 58:273, August, 1961.

The fact of being a nasal carrier of staphylococci is of less significance than the extent of colonization. Two hundred fifty hos-

pitalized patients were studied using slit-sampler air testing, which is more accurate than sweep plates.

Air samples of over 20 colonies per cubic foot of air were collected from the environment of 35 percent of patients who had over 100,000 colonies per nasal culture, but from only eight percent of patients who carried less than that number.

When the patients' sheets were shaken lightly for 15 seconds, there were twice as many positive samples and greater numbers of organisms per culture.

Of patients who were not nasal carriers, four percent had coagulase-positive staphylococci on their skin. Five percent of patients who had counts of less than 100,000 organisms per colony in a nasal culture had similar skin cultures; but 44 percent of patients carrying over 100,000 organisms had positive skin cultures. In 75 percent of instances, the staphylococci on the skin were the same phage type as those in the nose.

Carriers of small numbers of staphylococci appear to be no greater hazard as spreaders of staphylococci than noncarriers.

Blek, S.D., and Fleming, P.C.: "A New Technic for the Control of Hospital Cross-Infection." *Lancet* 2:569, September 10, 1960.

The greater the pollution of the environment, the more quickly the vulnerable patient is infected. The environment becomes a pool of organisms; the incidence of nasal carriers rises; discharge to the environment increases, and the patient is an accident within the cycle. Anything which interferes with the epidemiological cycle is an advantage. Nasal antibiotics have been tried and found to be esthetically objectionable. Furthermore, there is always the question—do they reach the critical areas in the nose?

In this study, it was reasoned that if a concentrated solution of penicillin, active against all pyogenic staphylococci, were sprayed into the environment, droplet nuclei of antibiotic would follow the same pathway as the staphylococci. An adequate concentration might reach the nasal mucosa; the discharge of staphylococci would be cut off, and the percentage of contaminating organisms in the environment would be diminished.

A synthetic derivation of penicillin with the same biological activity, BRL 1241 (Celbenin, from England), was chosen for study. Solutions of the compound were stable for several weeks when kept frozen. The dry powder was stable at room temperature for indefinite periods. Solutions containing 1,000 mg./ml., when stored at 37° C., lost all activity in two days; at 22° C., all activity was lost at five days; at 10° C., activity was lost in eight days.

A maternity unit was chosen for study. Ward and nursery were separate sections but administered by the same staff. Nasal swabs on newborns showed staphylococci in over 50 percent, with all but one harboring a penicillin-resistant strain.

A solution containing 1 Gm. in 20 ml. of distilled water was sprayed all over the ward and nursery for two minutes once daily. Positive nasal cultures dropped from 50 percent to 25 percent, with fewer organisms present in the positive cultures.

Then the treatment of the environment was stepped up to four times daily, and positive nasal cultures dropped to 12.4 percent. Coagulase-negative micrococci, resistant to BRL 1241, then appeared and gram-negative flora colonization was observed.

In the six months the units were sprayed with 4.1 Gms./day, 340 babies were born. Fourteen of these had minor lesions—sticky eyes or small skin pustules from which *Staphylococcus pyogenes* were recovered. There were no infections in the newborn housed in the treated unit.

Nasal cultures were done on 58 postpartum patients in the treated ward. Eleven were positive on the first day of treatment; after five days of exposure to the treated environment, there was one positive culture.

After six months experience with the environmental spray, dust cultures were made. In the control ward there were 20,000 pyogenic staphylococci per gram of dust. In the treated ward, there were none.

An attempt to obtain resistant mutants was unsuccessful, and it appears unlikely that resistant strains will emerge in clinical lesions. Because the drug is stable in its dry form, the authors believe there is a build-up of active BRL 1241 in the environment.

Farrer, Sanford M., and MacLeod, Colin M.: "Staphylococcal Infections in a General Hospital." *Am. J. Hyg.* 72:38, July 1960.

This is the story of a well-organized study of a general hospital of 804 beds and 68 bassinets. The study was undertaken in a nonepidemic environment and continued over a 12-month period.

A hospital-wide system of regular reporting was organized through the residents. A standard questionnaire was affixed to the patient's chart on admission. If infection was present at the time of admission, it was noted on the form. If infection developed during the hospital stay, details were entered on the form. If the clinical laboratories isolated coagulase-positive staphylococci in routine cultures, there was a followup to determine whether there

were manifestations of clinical disease in the patient.

The pathologists looked specifically for staphylococci at autopsies. Personnel were questioned and examined through employee health clinics, the outpatient department, student health clinics, and nursing service surveys.

Three types of infections were tabulated: those present on admission, with both clinical and bacterial signs; those acquired during the hospital stay, and those in personnel. The data on infections found on admission was difficult to classify, because 46 percent of patients had been admitted previously within the two months preceding.

Some interesting figures accumulated showed that 319 patients in the year acquired infections and the lowest rate was in the newborn (up to one month of age). Ward patients constitute 37.6 percent of the total hospital population, and 49.2 percent of the infections were in this group. Semiprivate patients constitute 49.2 percent of the total population, and 36.4 percent of the infections were in this group. The question is raised as to just how important is cross-infection on the open wards.

Forty-four percent of infections were in patients who had received antibiotics just prior to the onset of infection. Sixty percent of infections were in postoperative patients; 15 percent were respiratory infections, and 13 percent were cutaneous.

There was a definite and unexpected decline during the summer months.

Fifteen of the 19 services were involved; 52 percent of infections were on the general and neurological services. The lowest incidence was on the ophthalmological and obstetrical services.

Wound infections appeared 9.8 days postoperatively. Thirty-five percent were associated with digestive-tract surgery—predominantly on the gallbladder.

Sixty-five percent of infections were in surgery in the "clean" category—herniorrhaphy, mastectomy, sympathectomy, thyroidectomy. ("Dirty" surgery in this study included any with actual or potential contamination; intestinal resection; cholecystectomy; perineal surgery, and skin grafting of ulcers.)

Of the 66 personnel who had staphylococcal infections, 54 percent were nurses—19.7 percent, graduate nurses; 6.1 percent, practical nurses; and 28.8 percent students.

The hospital or epidemic strain and the community strain were the same 52/42B/80/81—and 32 percent of infection found on admission and 32.4 percent of hospital-acquired infections were of this strain.

Another interesting incidental finding was that the mortality rate is high with infections, but the death certificate is not an accurate index. Eighty certificates were reviewed in which infection was a known cause of death, and only half mentioned the presence of infection.

In 699 deaths occurring over the year, nine percent were associated with a staphylococcal infection.

Hospital stay went as high as 34 days, but the average was 10 days.

The prevailing assumption that wounds were infected in the operating room was investigated. The incubation period for a staphylococcal infection is one to two days, and an infection from a foreign-body reaction appears in 24 to 48 hours. The average postoperative infection, however, did not produce any exudate until nine days after surgery. This finding suggests very strongly that the wounds were being infected in the postoperative period. The authors caution that wound treatment and handling must be as precisely aseptic in this period as at the time of surgery.

The admission of community infections is as great a hazard as hospital-acquired infections, and isolation begins at the hospital receiving station, where patients suspected of infection are isolated until diagnosis is proven to be otherwise.

Singleton, A. O., Jr., and Julian, Jerry: "An Experimental Evaluation of Methods Used to Prevent Infection in Wounds Which Have Been Contaminated with Feces." *Ann. Surg.* 151:912, June 1960.

Wounds were made in a series of guinea pigs, were contaminated with direct smears of human fecal material and closed after treatment by one of a group of technics.

One series of wounds was closed 30 seconds after instillation of tincture of green soap, another after scrubbing for 60 seconds with gauze sponges and tincture of green soap. Other series repeated these maneuvers using a hexachlorophene soap; another, a detergent containing hexachlorophene; and a final series was closed after irrigation with 30 cc. of a one percent kanamycin solution.

Pus at 72 hours was considered indication of infection.

Scrubbing was considerably more effective than simple instillation (16 percent of the wounds in the former group were infected in contrast to 33 percent in the latter). The detergent-germicide and germicidal soap were comparable in action. The tincture of green soap was relatively ineffective, with 40 percent of wounds being infected after scrubbing, 46 percent after instillation.

Ten percent of the wounds treated with the antibiotic were

infected. The results being so equivalent to those obtained by scrubbing with the germicidal agents (16 percent), the authors suggest that there is little justification to using the antibiotic technic, considering the unfortunate sequelae of undisciplined antibiotic therapy.

The technic is suggested as one suitable for use when a wound becomes contaminated at the time of bowel surgery.

Condie, John D., and Ferguson, Donald J.: "Experimental Wound Infections—Contamination vs. Surgical Technic." *Surgery* 50:367, August, 1961.

What is the relationship of good surgical technic to wound healing?

The value of the tenets of good surgical technic was reconfirmed in this study in which bilateral wounds were made aseptically in a series of anesthetized dogs. Wounds were contaminated with an instillation of 2.5 ml. of fluid from a broth culture made from a patient's wound. Each instillation contained from 80 to 800 million staphylococci. The wounds were closed with a variety of technics using various suture materials. Daily inspection, cultures and histologic sections revealed that 70 percent of all wounds made were superficially infected, and in 88 percent of the 96 dogs used in the study, at least one wound was infected.

To emphasize the need for obliterating dead spaces in wounds, one wound was closed in four layers with a running 5-0 nylon suture, while its counterpart in the same dog was closed in seven layers, including the subcutaneous tissue.

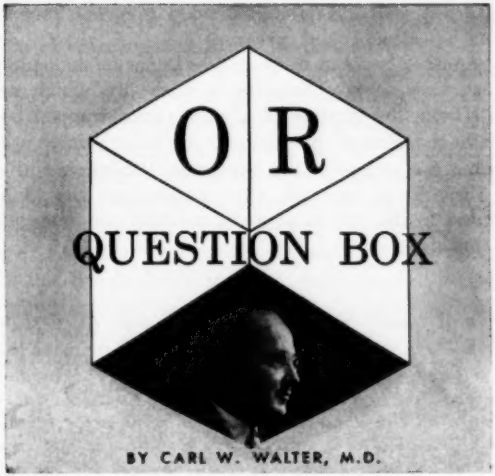
In the 12 dogs studied, there were three infections in the seven-layer closures, and 11 infections in the four-layer closures.

Washing a contaminated wound with 250 ml. of sterile saline during the closure is of debatable worth. Nine of the 12 which were washed were infected; 10 of 12 which were not washed were infected.

Superficial infection seemed to consistently accompany the use of interrupted cutaneous sutures and to be entirely absent when a continuous subcuticular suture was used.

Infection appeared to be increased by the use of heavy braided sutures, whether they were of silk or Dacron. Monofilament nylon was the least troublesome of sutures studied.

The notion that extra handling and extra sutures incidental to multiple-layer closures increase the incidence of wound infection seems to have been proved groundless by this study. Accurate matching of tissue layers and obliteration of dead spaces appear to contribute significantly to good wound healing.




Assisted by Dorothy W. Errera, R. N.

*Q. Is a brush necessary for scrubbing the operative area?*

A. The need for mechanical cleaning varies with the patient. The average individual's bathing habits remove most soil. But others, particularly the elderly or underprivileged, have a major problem in skin hygiene. In some hospitals, patients receive a supervised bath or shower on admission. The patient who is prepared for elective surgery with instructions for washing the operative site daily will come in for surgery with clean, disinfected skin.

When imbedded dirt is a problem in a patient, it should be attacked whenever possible preoperatively with detergents, bleaching agents, abrasive cleaners and fat solvents.

One surgical crisis depends on the use of a sterile brush for cleaning. This is the preparation of a traumatic wound or open fracture for excision and debridement. The injured part is positioned over an irrigating pan, and an iodophor or watery mixture of calcium hypochlorite is applied to the wound edges. The area is scrubbed with a sterile normal saline.

*Q. Is the unit used for cleaning the hands in the film on hospital infections a portable hand-washing facility?*

A. The unit shown in the film, "Hospital Sepsis: A Communicable Disease," is a freestanding, floor model liquid soap dispenser. In this instance, it is used to dispense a germicide for disinfecting the skin of the hands. This technic is preferred to the

hand-basin technic because it eliminates problems of dilution and inactivation of the germicide by soil.

*Q. Given a choice, is there any preference for basins of germicidal solution for hand rinsing in a patient's room over washing under running water with a germicidal soap?*

A. Washing under running water with a germicidal soap or detergent served from a dispenser is the ideal method. But hand-washing facilities are not always ubiquitous, and other means for safe skin disinfection must be provided.

A basin of germicide is a suitable substitute, provided quantity and concentration are rigidly policed. Every pair of hands immersed in the basin will remove some active ingredient, dilute the residual, and leave behind enough soil to seriously interfere with germicidal action. Hence, hand basins must be replenished at regular and frequent intervals to maintain an optimum and lethal concentration.

*Q. Several third-degree burns over pressure areas in patients after surgery have led us to seriously consider changing our skin disinfection. We currently use consecutive, non-alternating scrubs with tincture of green soap, tincture of a quaternary ammonium compound, and 70 percent alcohol. The burns have occurred in pressure areas during procedures involving more than two hours and in patients without evidence of vascular insufficiency. They have been at the depressed or "puddle" sites of the operating-table pad, and we have concluded they are the results of alcohol and pressure.*

A. Another cause of third-degree burns on dependent areas such as you describe is flash fire which results from the ignition of alcohol vapor trapped beneath the drapes by cautery or endothermy used during the course of the operation. Whenever either of these is to be used, skin disinfection should be limited to the use of aqueous solutions of detergent germicides.

*Q. Is it good technic to refilter the 70 percent alcohol which the obstetricians and pediatricians use as a hand rinse in the delivery room? The alcohol contains particles of pHisoHex or Septisol which remain on the doctors' hands and arms after scrubbing. The alcohol is collected in a container and runs into an open-neck jar. It may remain for several days, and then is refiltered and placed in a closed container. In an emergency, this alcohol is used after just a quick hand wash.*

A. Alcohol is an effective germicide for vegetative organisms if it is properly applied with friction and if the concentration is lethal at all times.

Solutions of alcohol are unstable. As evaporation occurs, the losses of water and alcohol are not

equal, and the original 70 percent solution may evaporate to a dilution that is non-germicidal. Alcohol in a basin is also diluted when successive pairs of dripping wet hands are immersed.

Solutions of alcohol can be clarified by filtration as you describe, but after filtration they must be restored to original strength by addition of pure alcohol or distilled water. To do this, two things are needed—an alcoholometer to measure the specific gravity and temperature of the filtered solution and a nomograph to identify the steps necessary to restore the solution to proper concentration. All this is predicted on the assumption that the original solution is a 70 percent "weight percent," which indicates the weight of pure alcohol in the total weight of the solution.

It is simpler and more economical to use alcohol from a dispenser which serves a few cc. at a time into a pair of hands. The solution is rubbed into the skin, and to obtain optimum bactericidal benefit, it is allowed to dry either in room air or with the aid of an electric hand dryer.

*Q. How long are brush dispensers considered sterile? Should dispensers be reautoclaved daily if unused or partially used?*

A. Scrub brushes are terminally sterilized to avoid implanting organisms from one pair of hands to another. No attempt is made to keep the brushes sterile during use. Brushes are removed from a dispenser until the latter is emptied. The rack and rinsed brushes are then reassembled, terminally sterilized, and returned to use.

"I've just discovered that the actor in Room 112 used a stand-in for his operation."

*Q. Do you think that glove basins should be eliminated from the operating room?*

A. The surgeon and members of his team need to wash their gloves from time to time during an operation to remove blood and annoying bits of tissue. This boasts morale and facilitates work.

A few precautions, however, are in order. Once the solution is fouled with glove powder, it must be changed, because foreign-body wound reactions are frequently associated with implants of glove powder.

When malignancy is encountered, the solution is changed to avert the carry-over of malignant cells to unaffected tissues. Similarly, when infection is present, the glove basin must be considered with drapes and instruments in taking measures to prevent the spread of infection.

Because many germicides are inhibited by protein soil, solutions in glove basins must be changed frequently to avoid dilution of bactericidal effect.

*Q. I have read that soap will neutralize Zephiran. Does it neutralize the G-11 preparations as well?*

A. The quaternary ammonium compounds (Zephiran, Roccal, Ceepryn, Detergicide, to name a few) are cationic germicides. They react with anionic agents, and their activity is impaired. Soap is an anionic wetting agent. When it is used in conjunction with a quaternary, all traces of soap must be removed to avert dermatitic reactions and inactivation of the germicide. Soaps containing hexachlorophene (G-11) have this same incompatibility.

*Q. Do electric hand dryers stir up unnecessary dust and interfere with the ventilating system? Doesn't the hot air contaminate the skin after it has been scrubbed?*

A. Electric hand dryers are mounted five feet above the floor with the nozzle directed towards the ceiling. The hot air that issues from such a dryer is sterile. Bacteriologic studies are published in *Public Health Reports*, March, 1953, in the article, "Mechanical Air Drying of Hands Following Preoperative Scrubbing," by Dr. Paul E. Walker.

*Q. Are electric razors or depilatories satisfactory for preoperative preparation of the skin?*

A. The electric razor does a poor job for a surgical shave. It does not remove desquamating epithelium, and clippings which scatter freely are difficult to contain. Depilatories are slow and time-consuming but are particularly useful on skin with dermatitis.

*Q. Is the consistent use of bactericidal soaps and detergents changing the flora of skin or its resistance to degerming agents?*

A. To date, there is no evidence to show development of such resistance.

*Q. When doing a dressing on the wards, how long can a wet sponge be left on a sterile field before the entire setup is considered contaminated?*

A. It is best to provide sponges saturated with germicide at the time of the dressing. Then wet sponges do not present a great problem on the sterile field, because the germicide disinfects the tray as it runs out of the sponge.

*Q. Which agents are most effective for disinfecting patients' thermometers?*

A. The terminal disinfection of clinical thermometers is concerned chiefly with destruction of the tubercle bacillus.

The *Mycobacterium tuberculosis* is protected by a waxy membrane and has a high lipid content. It is also protected by the mucus of sputum left on a thermometer. It is an unusually tough and resistant organism which may live for many months in dry sputum. In particles of dried sputum circulated in the air with dust, the organism may remain alive for eight to 10 days. Dried organisms are more resistant to chemical disinfection than organisms which are moist or hydrated. The bacillus is resistant to acids, alkalies, soaps, and synthetic detergents. The tuberculocidal effect of a disinfectant must be specifically evaluated on pathogenic varieties of mycobacteria.

Alcohol is unsatisfactory for use because it coagulates the sputum around the bacilli and does not penetrate. This limitation is common to many classifications of disinfectants; hence, it is imperative that the thermometer be wiped clean before immersion.

Immersion for 10 minutes in a solution of 70 percent ethyl alcohol and 0.5 to 1 percent iodine will destroy pathogens. Detergent iodophor solutions are also effective. These combine the removal of the residual sputum with tuberculocidal action. An adequate concentration of germicide is essential, and manufacturers' directions for use should be followed.

Alcoholic solutions of quaternary ammonium compounds are also effective against the tubercle bacilli.

An excellent film strip showing details of a technic for terminal disinfection of clinical thermometers is available from the Communicable Disease Center, Public Health Service, Atlanta 22, Ga.

A group of Russian scientists caused a stir in medical circles recently when they visited several large U. S. cities with their suturing device that uses staples. One of the devices—there are 20 separate adaptations of the original design—is especially created to suture tiny nerves and blood vessels during surgery. Other adaptations have been used to tie off tissue after resections, and in the final skin closure after surgery.

Several large American medical centers are already using the device, which has been hailed as a boon to all surgery, but particularly for surgery in the poor-risk patient, who requires shorter anesthesia, because of its time-saving features. In a lung resection, the stapler, dispensing a series of tantalum staples, cuts the suturing time to two minutes or less, in contrast to the conventional method, which may require about 18 minutes.

During their stay in Chicago, the Russian medical scentists performed a lung resection on a dog to demonstrate the stapling apparatus. Here the visitors discuss the new device at Northwestern University Medical School. L. to r. G. A. Nikolaev, chief engineer of Amtorg Trading Corp.; William Merz, vice-president of V. Mueller & Co., which will market the machine in the U.S.; I. Surin, senior engineer at Moscow's Institute for Experimental Surgical Apparatus and Instruments, where the device was developed; Prof. Mikhail Ananyev, director; John M. Danielson, administrator, Evanston Hospital; Prof. Sarkis A. Mushegian, chief surgeon; and Nikolai S. Gorkin, chief engineer.

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By Dorothy W. Errera, R.N.

### Skin Disinfection; Chemical Disinfection

Miller, Joseph M., Jackson, Deborah A., and Collier, Charles S.: "An Investigation of Plastic Dressings for Clinical Use." *Am. J. Surg.* 102: 115 July, 1961.

Plastic spray-on dressings are compounded to adhere to the skin, be nonirritating and nonsensitizing, and provide essentially tough, flexible transparent dressings for wounds.

They are also intended to act as barriers to entry of bacteria to a clean wound and to exert microbicidal action. These two features were studied in three different spray-on dressings available commercially. Two are compounded with bactericides: the third is not.

To test microbicidal action, blood agar plates were streaked with broth cultures of *S. aureus, Strep. pyogenes, E. coli, P. vulgaris, Ps. aeroginosa, Aerobacter aerogenes* after processing and *Candida albicans.* Results showed that no sample was totally efficient as a microbicide. Results were the same when testing was done by placing dried films of sprays on inoculated plates as when sterile discs of filter paper with one surface sprayed were placed with the sprayed surface in contact with the agar plate.

Similar testing showed that no dressing produced a film impermeable to water and *S. aureus* when it was applied on a wet surface.

To test the efficiency of a spray applied to a dry surface, aliquots of broth culture were put on sterile slides and dried for 24 hours at 37° C. They were then placed in broth and incubated at room temperature for 24 hours. The bacteria were not affected by the dressings.

Convinced that the organism being used for the study, *Serratia marcescens,* was neither affected by being placed on a glass slide nor by the application of dressings to the wet smear, the investigators then prepared similar slides, sprayed them twice, and this time dried them for one hour at 37° C. After incubation in broth for 24 hours at room temperature, no growth was recovered.

The same organisms were used for in vivo testing. Aliquots were placed on the skin of several patients. The areas were sprayed twice, and the patients were instructed to carry on as usual, with the exception that they were not to wash the areas. Cultures taken from the films were all negative.

The investigators reason that with a dry surface it should be possible to make an impermeable membrane with the sprays, because the molecules of plastic align themselves in a coordin-

ated film. Also, the more spray used, the more impermeability. Similarly, the smaller the surface sprayed, the more impermeability.

As a result of their investigations, they suggest using the sprays twice and always on dry surfaces. More efficient microbicides in formulae are also urged.

Goldman, Winfrey W., Jr., and Sanford, Jay P.: "An 'Epidemic' of Chemical Meningitis." *Am. J. Med.* 29:94, July 1960.

Five full-term, uncomplicated pregnant women in a period of 11 months developed acute purulent aseptic meningitis within 14 hours of spinal anesthesia administered for delivery. The purulent spinal fluid and other symptoms suggested a bacterial meningitis but no organism was ever found on stained smears of cerebrospinal fluid sediment.

After ruling out bacterial causes, the possible non-bacterial causes were explored. It could have been due to trauma with bleeding in the intrathecal space, but the cerebrospinal fluid was not bloody or xanthochromic. It could have been anesthetic aggravation of underlying disease of the central nervous system, but none could be exhibited. No patient had any symptoms even remotely suggestive of this possibility.

The conclusion that it was an inflammatory response followed and hospital technics were studied. Ampules of drugs, syringes and anesthesia sets were sterilized in heat. Ampules were never soaked in germicide so this documented source of trouble was eliminated as a cause. But for some reason syringes *were* soaked in a phenolic germicide after use before cleaning and resterilization.

After an exhaustive review of technics throughout the hospital, it could only be concluded that the residual phenolic in the syringes was responsible for the meningitis. Chemical contamination of syringes is a serious danger.

Bruch, Carl W.: "Decontamination of Enclosed Spaces with Beta-Propiolactone Vapor." *Am. J. Hyg.* 73:1, January 1961.

A variety of spaces in a hospital with an epidemic problem of staphylococcal sepsis was decontaminated and the process evaluated:

1. An operating room with all normal equipment except anesthesia tanks—a total of 1,800 cubic feet.

2. A premature nursery with its equipment—4,000 cu. ft.

3. A new, unoccupied maternity ward before furnishing—36 rooms, 89,000 cu. ft.

4. A new viral-vaccine production building.

5. A burn-dressing room with bed, mattress, chair, air conditioner—2,500 cu. ft.

All had painted plaster walls and asphalt-tile floors with the

exception of the operating room which had a conductive terrazzo floor.

Openings to untreated rooms were taped and sealed.

Filter paper strips were inoculated with known quantities (approximately 100,000 spores) of aqueous, heat-shocked suspensions of either *B. subtilis* var. *niger or B. stearothermophilus*. Spore strips were placed on half-open petri dishes and located in a variety of places in the rooms. After decontamination and before ventilation, the petri dishes were closed and removed.

The relative humidity in the rooms ranged between 70 and 100 percent. Lactone and water were atomized from a pushcart dispenser. When necessary, additional fans were used to move the vapor into openings and crevices. The total quantity of lactone used was calculated on the basis of 10 mg. per liter of space. The recommended dose is 2-4 mg./L. space for at least two hours. Areas were exposed for two to four hours.

Multiple room areas were ventilated for 10 to 18 hours. The charcoal filter on the atomizer was used to absorb the lactone from an individual area. The room was considered safe to enter if there was no nasal irritation or lachrymation after 30 minutes exposure.

Safety precautions included gas masks with canisters, plastic hoods, and rubber suits for personnel entering the areas during the tests. After a few hours of ventilation, gas masks and laboratory clothing bound at the wrists, ankles, and neck were considered adequate. Safety goggles were worn when atomizers were being filled. Spillage was washed from the skin immediately and personnel removed clothing and showered after emerging from a test area.

Sterile spore strips were obtained in five out of six places. In the sixth location, the viral vaccine facility, five to 25 spores were left per strip from the original 100,000. Approximately 50 percent of the swab tests were sterile. Nonsterile swabs showed reductions greater than 99 percent (10-5000 organisms/swab pre-decontamination; three to 100 organisms after).*

The only damage encountered was that resulting when the spray impinged directly on a painted and varnished surface. No damage could be traced to the vapor.

Toxic properties were no obstacle during test and in actual use the elaborate precautions of gas masks, hoods, and rubber suits would not be necessary because remote operation of equipment is possible.

*B. stearothermophilus* is not

*Nonsterile swabs appeared to be the result of contamination during collection or failure of the vapor to penetrate small holes and cracks at the swabbed sites.

recommended for this use because there appears to be less resistance to the vapor than with *B. subtilis* var. *niger*.

The outstanding question to be resolved before this technic finds widespread application is the potential of carcinogenic activity now being studied on mouse skin.

Lee, John C., and Fialkow, Philip J.: "Benzalkonium Chloride—Source of Hospital Infection with Gram-Negative Bacteria." *J.A.M.A.* 177: 708, September 9, 1961.

Repeated warnings have been sounded about the need for caution when using the quaternary ammonium compounds for chemical disinfection. Their adsorptive properties have been described. Higher concentrations of solution to prevent deletion of germicidal agent have been urged. If the quaternary ammonium compounds are accidentally contaminated, they may support the growth of the contaminating organism, particularly if it is of the gram-negative group.

This report describes an outbreak of sepsis beginning with the admission of a woman with bronchitis, asthma and pneumonitis. An admission blood culture revealed a gram-negative bacterium of the Pseudomonas-Achromobacteriaceae groups. But this organism had no demonstrable part in her disease.

In the next six weeks, the same organism was recovered from blood and/or urine specimens collected from 15 patients with various diagnoses. All but one were housed on the same floor of this 15-story hospital.

Four patients had definite clinical sepsis associated with the organism; two died, and the gram-negative organism was believed to be a contributing factor.

Sixty-five cultures were done on the feces and urine of personnel whose contact with patients was most intimate. The urine and feces of several patients with septicemia were examined. Settling plates were exposed in various spots around the ward and corridor.

No organism resembling that of the original culture could be identified in any of these cultures. It was not until a container of cotton pledgets immersed in an aqueous solution of benzalkonium chloride was cultured that the organism was recovered. The pledgets were used for disinfecting the skin before intramuscular injections, before venipunctures, and before collection of urine specimens.

Workers in the central supply room, using their bare hands, loaded sterile containers with sterile cotton. The aqueous solution, made in the hospital pharmacy in unsterile glass containers with deionized water, was added. [*No mention is made of quarantine before use or of the amount of solution present in the container.—ED.*] Personnel

on the ward often removed pledgets with their fingers.

The authors do not suggest total abandonment of the quaternary ammonium compounds, but urge respect for their limitations and intelligent application. The need for strict asepsis is again emphasized with the emergence of the Pseudomonas as another organism responsible for increasing numbers of hospital-acquired infections.

Kundsin, Ruth B., and Walter, Carl W.: "In-Use Testing of Bactericidal Agents in Hospitals." *Appl. Microb.* 9:167, March, 1961.

Technics for bacteriological monitoring of the environment are described. Cultures of air, floors, textiles, furniture, shelves, necessary for measuring the effi- and lights are recommended as ciency of cleaning-disinfecting routines.

At least three cultures from different areas of a floor in a room are advised so that an inordinately high count, which may be due to transient heavy soil will not confuse the analysis of an otherwise sanitary environment. Floor culturing has been valuable for exposing contamination in waxes (one with gram-negative rods was found), brushes, and mops. It is also a valid measure for in-use testing of germicides and technics of application.

Floor waxes, with and without germicide, were tested on ward and corridor floors (4,000 pair of feet in 24 hours on the latter). No significant difference in results was noted. The advantage in the wax which incorporates a germicide appears to be the latter's ability to inhibit bacteria growth during storage.

That germicidal laundry rinses inhibit growth of bacteria in soiled linen awaiting laundering was demonstrated by culturing wash water during various phases of the laundering cycle. A total of six organisms could be collected from the *entire cycle* when linen consistently washed with a hexachlorophene tallow soap was being processed. But 400 to 600 could be recovered from any *one phase* of the cycle when untreated linen was being processed.

The environment in an operating room in which there were 12 changes of air per hour, with eight percent of the air recirculated through electrostatic air cleaners, and housekeeping-sanitizing procedures were rigidly enforced, consistently yielded an average of no more than five organisms per cubic foot of air, with a fallout of four bacteria-carrying particles/square foot/-minute.

The bacterial population of a hospital bursts as organisms are introduced by patients, personnel, and air currents. It declines as organisms are removed by cleaning and ventilating. If removal is not a continuing process, the population rises until the environment is overwhelmed.

# Can Direct-Vision Endoscopes Be Autoclaved?*

By Ralph G. Rigby, M.D., and Elaine Dedrickson Dyer, R.N.†

The problem of bringing about desired change is one of the important objectives in education. New information through research is one of the methods used to convince people that they should change.

Chemical-disinfection research evaluations recommend that only those items that cannot be sterilized by heat should be disinfected by chemical methods.[1,2,3,4,5] A survey of the literature reveals that there is no effective chemical solution which will sterilize instruments in 30 minutes. The fastest-acting germicide is irritating to tissues and must, therefore, be rinsed meticulously from the instruments. Considering the many pitfalls and limitations in using germicides, it seems that a more reliable method should be found. Autoclaving is the most rapid and reliable method of destroying micro-organisms.

It is held that some hospitals prepare their direct-vision endoscopes with chemical solutions because some of the manufacturers of endoscopic instruments recommend that their instruments not be autoclaved.

Knowledge of the limitations of disinfectants and the recommendations of the instrument manufacturers caused the writers much concern. A set of direct-vision endoscopes contaminated with tuberculosis organisms from one surgical patient with active tuberculosis required sterilization and use on an-

*Reprinted with permission from *Diseases of the Chest*, June, 1960.

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other patient. The tubercle bacillus is not a spore-former, but the waxy coat which surrounds it makes it difficult to destroy. It is considered midway between spores and vegetative bacteria in its resistance to destruction. Processes of preparation should, therefore, be geared to destroy spore-forming micro-organisms.

Because the greatest concern was felt for the safety of the patient, it was elected to autoclave the instruments in spite of the manufacturer's recommendation to the contrary. Careful examination of the instruments following the sterilizing revealed no visible damage to the instruments or their accessories. Subsequently, in situations resembling the above conditions, it was elected to sterilize the instruments with steam under pressure.

Sufficient investigation of the autoclaving method has been completed to lead one to believe that this method can be employed to prepare direct-vision endoscopes with complete safety for the patient and with only a minimal amount of damage to the endoscopes.

In connection with a research project for a master's thesis in 1955, the following tests were made.[6] A representative sample of endoscopic instruments was chosen from the supply cupboard. Care was taken to choose those instruments that were not used often so that the experimental instruments could be kept separate during the research project. The actual instruments tested are listed in Chart 1. Each separate piece of equipment was identified with a tag. The autoclaving and drying times and any special remarks were recorded on the tag during the research autoclaving period.

These instruments were autoclaved 101 times at 250°F. at 20 pounds of pressure, a total of 41 hours and 49 minutes, and dried for a total of 19 hours and 38 minutes. It was attempted to autoclave them 20 minutes and dry them 10 minutes each time. The drying was effected by leaving the instruments in the autoclave with the steam in the jacket turned on and the autoclave door open slightly. The instruments and bulbs were examined and tested after each autoclaving period for the first 51 tests. They were examined and tested following every two autoclaving periods during the second fifty autoclaving tests.

The instruments were examined and tested for:

1. Evidence of damage to the surface of the metals —discoloration or etching.

2. Evidence of damage to the soldered joints.

3. Evidence of damage to the rubber cord—stickiness of rubber, separation between the rubber-metal joints, corrosion on light terminals and damage to the terminal collars.

4. Evidence of damage to the light-carrier ter-

minals and bulbs—the light bulbs were checked to see if they would carry current and light. No attempt was made to determine how long the bulbs would burn.

5. The atomizers were examined to determine if they would spray. It was felt that any internal damage that the instrument sustained would prevent them from spraying.

No attempt was made to clean the instruments until the research had been completed. The bronchalloy metal was easily returned to its original appearance. The brass metal was cleaned with metal polish and proved more difficult to return to its original appearance. There was no evidence of etching on the surface of the metal. A section of the brass endoscopes and atomizers was left unpolished so that interested people would examine the effect of the autoclaving periods and contrast the polished area with the discolored area and also with the surface of the instruments that had never been autoclaved.

The effects of the autoclaving are summarized in Charts 1 and 2.

**CHART 1**

The following instruments were used in the research project and were autoclaved 101 times at 250° F. and 20 pounds of pressure, a total of 41 hours and 49 minutes, and dried for a total of 19 hours and 38 minutes. The drying was effected by leaving the instruments in the autoclave with the steam in the jacket turned on and the autoclave door opened slightly. The instruments were autoclaved in an open instrument tray.

No attempt was made to clean the instruments until the research was completed.

Some of the instruments were constructed from brass metal and some were made from bronchalloy metal. The following results were obtained:

| INSTRUMENT | EFFECT OF 101 AUTOCLAVINGS | EFFECT OF CLEANING |
|---|---|---|
| 1. Esophagoscope #1 9 mm. x 53 cm. (brass) | Markedly discolored, but the surface remained smooth. | Discoloration was removed with metal polish. |
| 2. Esophagoscope #2 9 mm. x 53 cm. (brass) | Same as above. | Same as above. |
| 3. Esophagoscope #3 7 mm. x 30 cm. (bronchalloy) | No discoloration of metal. Surface remained smooth and bright, but had a few water marks. | The water marks were readily removed with a water-moistened cloth. |
| 4. Esophagoscope #4 7 mm. x 30 cm. (bronchalloy) | Same as above. | Same as above. |
| 5. Light Carriers (bronchalloy) | No evidence of discoloration. Surface remained smooth and bright. | None required, except to the contact terminal on occasion. (See observations). |
| Carrier #A (with E.S.I. lamp in place) | Lamp burned out on 95th autoclaving period. A total of 38 hours and 59 minutes autoclaving time and 18 hours and 58 minutes drying time. The replaced lamp lasted through the rest of the project. | |

| | | | |
|---|---|---|---|
| | Carrier #B (with E.S.I. lamp out of carrier) | Lamp burned out on seventh autoclaving period. A total of 2 hours and 59 minutes autoclaving time and two hours and five minutes drying time. Replaced lamp lasted through the project. | |
| | Carrier #C (with Pilling lamp in place) | Lamp burned out on 87th autoclaving period. A total of 35 hours and 54 minutes autoclaving time and 17 hours and 48 minutes drying time. The replaced lamp lasted through the rest of the project. | |
| | Carrier #D (with Pilling lamp out of carrier) | Lamp burned out on 61st autoclaving period. A total of 25 hours and 39 minutes autoclaving time and 13 hours and 38 minutes drying time. The replaced lamp lasted through the rest of the project. | |
| 6. | Forceps globular objects 50 cm. (bronchalloy) | The bronchalloy parts unaffected. The blue tips showed a spotty color change and what appeared to be a small amount of corrosion. The surface of the blue tips remained smooth. | Corrosion easily removed with a water - moistened cloth. |
| 7. | Forceps globular objects 30 cm. (bronchalloy) | Showed some color change, but not as much as the above instrument. | Same as above. |
| 8. | Atomizer, Clerf 50 cm. (brass) | Surface discolored but remained smooth. Atomizer always sprayed, when tested, during the research project. | Discoloration removed with metal polish. |
| 9. | Atomizer, Clerf 30 cm. (brass) | Same as above. On the 51st autoclaving period, the glass-metal joint on the spray bottle separated. | Same as above. |
| 10. | Mirror, laryngeal angular boilable Size #1 (chrome plate) | No discoloration of metal. Some water spots were present. | Water spots removed with a water - moistened cloth. |
| 11. | Mirror laryngeal angular boilable Size #00 (chrome plate) | Same as above. | Same as above. |
| 12. | Cord, Jackson battery #A black rubber with two black terminal sleeves | No apparent damage. | Required no cleaning. |
| | #B black rubber | No apparent damage. | Same as above. |
| | #C brown rubber cord, with one red and one black terminal sleeve | No apparent damage to the rubber, however the red terminal sleeve developed small cracks. | Same as above. |
| | #D brown rubber cord, with one red and one black terminal sleeve | Same as above. | Same as above. |

## CHART 2

OBSERVATION OF INSTRUMENTS FOLLOWING 101 AUTOCLAVING PERIODS

1. The bronchalloy instruments showed no evidence of discoloration. There were a few water marks left where droplets of steam evaporated during the drying process. These were easily removed with a water- moistened cloth.

2. The brass instruments were markedly discolored, but the surface remained smooth and there was no other apparent damage. This discoloration was removed with metal polish. After cleaning, they appeared to be the same as those instruments that had never been autoclaved.

3. The lighting systems revealed no evidence of damage other than those noted in Chart 1. The electrical terminals on the carriers, lamps, and cords seemed to be less affected by the number of autoclavings than by the nature of the load that was autoclaved just prior to them. When Vaseline was autoclaved preceding the endoscopes, all of the terminals required cleaning with the Inperatori Cleaner.

4. The bronchoscopic forceps showed no evidence of being damaged except that the blue tips on the forceps showed spotty discoloration and a small amount of corrosion. The surface of the tip remained smooth. The corrosion was removed with a moistened cloth.

5. The Clerf Atomizers worked well throughout the research. The brass discolored as noted above. On the 51st autoclaving, one of the spray bottles separated between the glass-metal joint.

6. The cost of a Pilling-made Jackson Lamp is $2.15 . . . the same model manufactured by the E.S.I. Company is $1.48. The Pilling-made Clerf Bottle costs $1.75. (These prices were obtained from our supply department.) Two Pilling lamps burned out. Two E.S.I. lamps burned out. One Clerf Bottle separated during the 101 autoclaving periods. This is a total cost of $9.01, or slightly less than $.09 per autoclaving period.

These data were circulated to 171 Veterans Administration hospitals in the United States. Ninety of the hospitals reported they were autoclaving all or part of their endoscopic equipment prior to receiving our research results. Forty-one of the hospitals reported they were using chemicals to prepare their instruments. Fourteen reported that endoscopic examinations were not performed in their surgery. Twenty-six failed to return the questionnaire. Twenty of the 41 hospitals using chemicals to prepare their endoscopes reported they switched to the autoclaving process after receiving our research results. Both of the hospitals where the authors work have used the autoclaving process for the three years that have elapsed since the original research project.

Approximately 522 endoscopic examinations have been completed at one hospital and 252 have been completed at the other, a total of 774 autoclaving periods, under our personal supervision.

The instruments present no further evidence of damage. It appears that the minor changes that occur

in the instruments during the first few autoclaving periods, and as reported in the original research results, are all that can be expected to take place. The cost of instrument upkeep is minimal and the patient is safe from cross-contamination.


*Summary*

*The autoclaving method has been demonstrated to be effective and economical for preparing direct-vision endoscopic instruments.*

*Bronchalloy is superior to brass when the autoclaving method is employed.*

*Black rubber cords appear to be superior to brown rubber cords because of the stronger black terminal collars.*

*There seems to be a weakness where cement is used between metal and glass.*

*From our experience, autoclaving is the method of choice for preparing direct-vision endoscopes.*


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"A half inch more to the left and I'd have to turn her over to a GYN man."

# Wrapping Surgical Packs in the Laundry

By Vivian Warren, R.N.*

It pays to make surgical packs in the laundry, we are convinced after seven years experience with this method at the White Memorial Hospital, a 252-bed hospital in Los Angeles.

Before this system was adopted, all supplies and packs were assembled in the operating-room workroom—in a space that not only was inadequate for such work but also was needed for operating-room equipment. After considerable thought we decided that the most logical place in which to make these bundles was at the source of supply—the laundry.

Two major factors had to be considered in making this change: (1) the need for adequate space, either in the laundry or in the adjoining sewing room, and (2) the necessity for teaching untrained personnel to be competent in the proper folding of linen and in the following of precise specifications in making up the bundles.

It was decided, after some consideration, that the laundry workers could learn "bundle-making" much more easily in the operating-room workroom. After one month of indoctrination these workers could assemble and wrap packs of various types by following lists of the specific articles put into each of the 13 different packs used. When the laundry workers were able to assemble packs effectively, the operating-room personnel were freed for more complex duties.

Now each day the operating room sends the laundry a list of its needs for the following day. This eliminates excessive inventory of linen in our sterile supply cupboard. Six hundred operations a month are performed in the hospital. At present it requires 60 hours a week for the laundry personnel to fold linen and make the packs. This work is done in a 10′ x 20′ floor space in the laundry. After the packs are assembled, the laundry sends them to the central service department to be autoclaved.

Thorough planning, good supervision, and effective communications will make this departure from usual O.R. procedure an innovation which will improve efficiency and cut cost of operation by:

(1) Releasing trained O.R. personnel for more skilled, technical duties.

*At the time this article was written, Miss Warren was operating-room supervisor, White Memorial Hospital, Los Angeles. She is now operating-room supervisor, California Lutheran Hospital, Los Angeles.

(2) Limiting the extra handling and refolding of linen.

(3) Assuring better production work.

(4) Providing for better housekeeping in the operating room, by the elimination of lint.

(5) Allowing vitally needed O.R. space to be used to better advantage.

(6) Making it possible for linen to be checked and replaced immediately.

Another part of our program which we believe has added to our efficiency is the use of 13 specified surgical packs instead of three or four major and minor packs.

The contents and costs of the 13 packs are listed below. The cost of each includes wages of personnel and replacement cost of linen, based on 200 uses before replacement is necessary.

All linen is placed in order of its use. The folded towel is placed on the bottom of a pack so that the pack can be lifted and put on any area of the table.

**Winged Laparotomy Pack**—cost, $1.30
(Wrap in double sheet)
1 towel opened in half
1 laparotomy sheet
5 surgeon's towels
1 set incision pads (field cloths)
1 suture bag
20 4x4's
20 Rondic sponges (we call them "stick sponges")
10 laparotomy sponges
1 ABD
1 small Telfa
2 Mayo covers
6 washcloths

**Thyroid Pack**—cost $1.78
(Wrap in double sheet)
1 towel opened in half
7 surgeon's towels
1 special thyroid sheet
2 plain sheets
2 surgeon's towels
1 plain sheet
20 4x4's
5 lap sponges (we call them tapes)
1 Telfa
1 ABD
2 Mayo covers
1 suture mitt
6 washcloths

**Head Pack**—cost, $1.78
(Wrap in double sheet)
1 towel opened in half
2 surgeon's towels
1 head drape with 3 towels folded together
20 4x4's
1 Mayo cover
1 suture mitt
6 washcloths

**Brain Pack**—cost, $1.51
(Wrap in double sheet)
1 head towel
1 special sheet
1 brain sheet
1 Dr. Vogel's pad (a quilted pad that fits a special table for craniotomies)
1 plain sheet
1 surgeon's towel
1 double sheet
4 surgeon's towels
50 4x4's
1 Telfa
1 suture mitt
1 Mayo cover
6 washcloths

**Rhinoplasty Pack**—cost, $1.69
(Wrap in double sheet)
3 surgeon's towels
1 head sheet with two towels folded together
2 ENT sheets
7 surgeon's towels
20 4x4's
2 Mayo covers
1 suture mitt
6 washcloths

**Vein Pack**—cost, $0.93
(Wrap in double sheet)
1 towel opened in half
1 special sheet
8 surgeon's towels
1 plain sheet
20 4x4's
1 Telfa
1 suture mitt
7 washcloths

**Lithotomy Pack**—cost $0.79
1 surgeon's towel
1 rectal sheet
2 leggings
5 surgeon's towels
1 perineal pad
1 bowl
4 washcloths

**Breast Pack**—cost, $1.92
(Wrap in double sheet)
1 towel opened in half
4 surgeon's towels
1 breast sheet
4 surgeon's towels
1 bath towel
3 surgeon's towels
1 plain sheet
10 Rondic sponges
10 tapes
20 4x4's
1 ABD
1 Telfa

2 Mayo covers
1 suture mitt
6 washcloths

**Orthopedic Pack**—cost, $1.90
(Wrap in double sheet)
1 towel folded in half
3 surgeon's towels
1 special sheet
1 split ortho sheet
2 surgeon's towels
1 head sheet
1 special sheet
1 plain sheet
10 tapes
20 4x4's
1 Telfa
1 head sheet
1 suture mitt
6 washcloths

**Chest Pack**—cost, $2.00
(Wrap in double sheet)
1 towel opened in half
4 surgeon's towels
2 special sheets
3 head sheets
4 surgeon's towels
1 suture mitt
1 large Telfa
20 4x4's
1 large pillowcase
10 Rondic sponges
8 surgeon's towels
1 large Mayo cover
1 Mayo cover
6 washcloths

**Eye Pack**—cost, $1.32
(Wrap in double sheet)
1 special sheet
1 head sheet with 2 surgeon's towels
2 surgeon's towels folded together
1 eye drape
4 surgeon's towels on top
20 4x4's
5 2x2's
4 surgeon's towels
1 Mayo cover
1 suture mitt
6 washcloths

**Cystoscopy Pack**—cost, $0.39
1 drape sheet with two holes
2 cysto leggings
1 gown
1 hand towel (all our hand towels are turkish toweling)

**Gown Pack**—cost, $0.17
1 medium gown
1 hand towel

# Cellophane Tubing Proves Effective Wrap for Sterilization

Cellophane, long familiar to other industries as a packaging medium, is now becoming increasingly popular in the hospital. Photos on these four pages illustrate the step-by-step method of properly wrap-

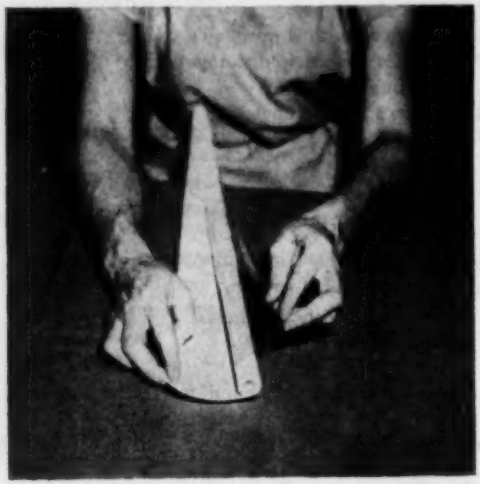


fig. 1

fig. 2

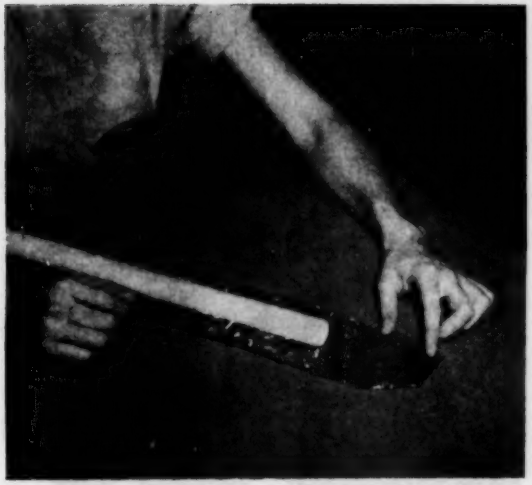


fig. 3

fig. 4

ping an item in extruded cellophane tubing for autoclaving.

The item being wrapped in the demonstration is a plastic film surgical drape, the type used with a spray adhesive.* All photographs were taken at University Hospital, Ohio State University Health Center, Columbus, with the cooperation of Marjorie J. Reed, R.N., operating-room supervisor.

In fig. 1, the plastic film is shown interleaved with paper in a roll to aid in steam penetration and to facilitate handling. The roll is inserted in the cellophane tubing which has been dampened to assure sufficient steam (fig. 2). One end of the tubing is left

*Vi-Drape, manufactured by the Aeroplast Corp.

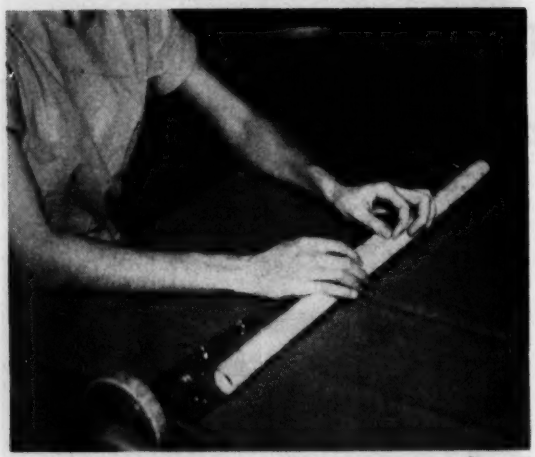


fig. 5

open during sterilization, the other end closed, using the folds shown in figs. 3 and 4.

Fig. 3 shows the first two folds; the corners of the tubing are folded in at an angle, then the top is folded down over them. The top is then folded down again and secured with a paper clip (fig. 4). Autoclave tape is applied (fig. 5), and the packaged article is subjected to 250° F. for 30 minutes.

After autoclaving, the open end of the package is closed with three folds (fig. 6), and cellophane tape applied across the folded end of the tubing, as in fig. 7. The ends of the tape are folded over at the sides of the tubing and pressed down, forming an effective seal (fig. 8).

In addition to its use in the packaging and sterilization of the plastic surgical drape, the cellophane tubing has also been used to package other tube-shaped items, including catheters and tubing. The cellophane material is available in several sizes.

fig. 6

fig. 7

fig. 8

*Q. How long must an instrument which has been dropped on the floor during surgery be soaked, using Pheneen or Zephiran 1:1000?*

A. Both compounds are quaternary ammonium agents, and immersion for 18 hours is necessary. The instrument would have to be free of grease, oil, and dirt when immersed.

If the instrument has been contaminated with blood or tissue fluid, the chemical agents will be impotent against the virus of homologous serum jaundice, which is a potential and undetected contaminant of the blood stream.

*Q. What germicide should be added to the ice-maker in the hospital?*

A. Water in most communities is treated with a bactericide to control the spread of organisms, so that the water used in the ice-maker is no problem. The problem of contamination begins with the ice handling, storage, and so forth. The local public health department will furnish information on water treatment in the particular community.

*Q. How is the suction bottle handled after a septic case?*

A. After any case, residual germicide solutions from the field and glove basin are added to the bottle to dilute blood and drainage fluids. The bottle is then emptied directly into a flushing rim sink, the contents poured low and close to the drain to avoid splashing. The bottle is terminally sterilized in the instrument washer-sterilizer or steam sterilizer.

*Q. We wish to sterilize mercury to be used in a glass "U" tube which is connected directly to the*

*circulation during open-heart surgery by an air-free column of fluid. Arterial pressure can be monitored with this setup without more complicated instruments. Because the patient's circulation is separated from the mercury in the tube only by a column of sterile saline, we believe that the glass tube and the mercury should be sterile. Can the mercury be sterilized?*

A. Metallic mercury is usually considered self-sterilizing because of its oligodynamic action. Failures result when dry dust and dirt float on the mercury and bacteria in these escape the germicidal action of the metal itself; hence, the quantities of the metal sufficient to fill a manometer are best sterilized in a clean, stoppered glass container at 250° F. (dry heat) for four hours.

Care must be taken to clean the mercury and the glass manometer tube with a non-ionizing detergent after each use to remove residual blood in which bacteria might proliferate during storage. Gram-negative bacteria cause pyrogens that can cause boils and fever when the equipment is next used in circuit with the blood stream. The glass "U" tube is readily sterilized by steam.

*Q. If a package is to be sealed in plastic after sterilization, is it still necessary to use a four-thickness wrapper?*

A. Unless the wrapper must serve as a sterile field when the package is finally opened, a double-thickness wrapper is adequate for the package which is to be sealed in plastic immediately after sterilization.

*Q. Is it necessary to wait two weeks for a report when using commercially-prepared spore strips?*

A. Yes. The same bacterial characteristics are present and it often takes 14 to 15 days for a culture to become positive.

*Q. Can cardiac catheters be autoclaved?*

A. Nylon and certain polyvinyl chloride catheters are heat-stable and withstand exposure to steam at 250° F. The lumen must be flushed with distilled water before sterilization, just as with any other catheter or hollow tube.

*Q. We have been autoclaving ureteral catheters without stylets, but because the surgeon complains that the catheters are not rigid enough, we would like to sterilize them with stylets in place. Will there be any interference with sterilization?*

A. Catheters can be sterilized with stylets in place. The catheter is rinsed as usual with distilled water immediately before sterilization to provide the necessary moisture for steam sterilization. The fit be-

tween stylet and catheter is seldom so snug as to interfere with air clearance.

*Q. Do you have to leave one end of cellophane tubing open during sterilization? Isn't there danger of contamination when the open end is closed at the end of the cycle? Can this tubing be reused?*

A. When catheters packaged this way are sterilized, one end of the tubing is left open to provide access for steam, to prevent sticking of the cellophane to the catheter, and to prevent bursting fractures of the tubing, which are not uncommon when the package is sterilized with both ends closed.

The open end is long enough so that the masked worker who completes the seal at the end of the cycle is not likely to contaminate the contents.

The cellophane tubing is too inexpensive to justify the time and effort of collection and inspection for defects before reuse.

Q. *Is it necessary to wet the inside of Penrose tubing before sterilization?*

A. Penrose tubing is usually sterilized with a wick in place to aid drainage. The wick separates opposing surfaces of the tubing so that there is no interference with steam contacting the inside. If Penrose drains are packaged for sterilization without the interposed wick, a few drops of distilled water inside the tubing will expedite the formation of steam, clearance of air, and sterilization of all surfaces.

*Q. How do you suggest positioning a shallow lid for sterilization in an autoclave? We hesitate to sterilize it with the inside uppermost because of the possibility of trapping air; if it is placed with the inside surface down, will steam contact the inner surface?*

A. There is no problem of air clearance in a shallow or flat lid; hence it can be sterilized in whatever position allows for safe and convenient removal from the sterilizer. It can be sterilized face downward on the perforated sterilizer carriage or atop a load of dry goods. Unless it is weighted down to a point where a tight seal is effected, there is no interference with the circulation of steam.

The lid can be sterilized face up. If there is any question of trapped air, a few drops of water left on the inner surface will assure the presence of microbicidal steam.

In addition, these lids can be sterilized upright wedged between other supplies. They should be arranged to be within easy reach when the sterilizer carriage is unloaded so that they can be grasped without contamination.

*Q. Our surgeons often bring their own instruments to the operating room, saying they are "sterile," and*

*it is a running battle to get them to agree to let us sterilize the instruments again before use. Do you think we are wrong to insist?*

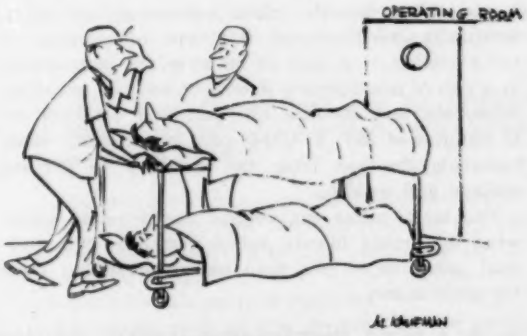
A. Although the instrument may have been originally properly wrapped and sterilized, one must always consider the question of possible contamination from improper handling in the interim before use. There is also the possibility that the outer wrapper may have been exposed to contamination during transportation. Under these circumstances, it is wisest to insist on preoperative sterilization of all instruments immediately before use.

On the other hand, if your colleague in another hospital is competent and she has wrapped and sterilized an instrument well and placed it in a clean outer wrapper, and the surgeon has delivered it promptly to you for immediate use in a case, there would be no reason to assume that it was unsafe.

*Q. All the reports I have read state that instruments must be opened before autoclaving. Many hospitals do not follow this practice, and in our own hospital we conducted the following experiments. Several sets of instruments were autoclaved locked. The box locks were then cultured and all culture reports were negative. Have you any comments?*

A. The usual culture test is meaningless unless spores (dry) of established heat resistance in known populations are used. Two strains are commonly used for testing sterilizer efficiency: *Bacillus subtilis* var. *globigii* and *Bacillus stearothermophilus*. Cultures are examined at various intervals, up to 14 days. Unheated controls are cultured simultaneously and all negative cultures are inoculated at the end of the incubation period to prove that the culture medium is effective.

It is possible that you have obtained negative results because the instruments were well cleaned before sterilization and hence uncontaminated. There may have been enough moisture left in the locks




"Whew—busy busy!"

to provide the steam necessary for sterilization. Your culturing technics may have been too superficial to be conclusive.

The fact remains that steam, to be an effective microbicide, must reach every surface to be sterilized so that surface is wet and heated to microbicidal temperatures.

*Q. Will steam penetrate pus, blood and mucus on dirty instruments?*

A. Dried blood and pus can be sterilized by prolonged exposure and heat in a sterilizer. The instrument washer-sterilizer is rapid and superior for the purpose because the soil is solubilized and removed. When heavily soiled instruments are to be terminally sterilized and this type of sterilizer is not available, it is best to immerse the instruments in a pan of non-foaming detergent such as trisodium phosphate and sterilize the pan and contents for 45 minutes at 250° F. Great care is necessary when removing the pan from the sterilizer to prevent spillage and scalding.

The scrub nurse can control the situation somewhat by rinsing bloody, soiled instruments in residual solutions on the field before arranging them for sterilization.

*Q. At a recent operating-room institute, the class was told that instruments used in a cancer case had to be put directly into a sterilizer for terminal sterilization to prevent spread to another patient, and that gloves used in the case should be burned. Our surgeons object to this technic, saying that cancer is not transferred from patient to patient in this way. We do a great deal of cancer surgery, and I am interested in following a safe technic.*

A. The transmission of cancer from patient to patient by means of bloody instruments has not been established in humans.

However, the implantation of cancer cells from the tumor to surrounding tissue or the wound is a recognized hazard. Instruments which have been used in tissue that potentially harbors cancer should not be used again until they have been treated to destroy the cancer cells. Brief immersion in Dakin's solution or an iodophor suffices for this. Gloves should be rinsed frequently. Swaged-on needles and short ties instead of ligature reels also help to confine the cells.

Surgical technics have been elaborated to confine the spread of cancer cells within the individual patient. Using the high-frequency scalpel, walling off the wound with impermeable plastic, ligating the gut above and below a cancerous lesion to prevent massage of cells to the area of resection, and irrigating the wound with Dakin's solution prior to closure are examples.

Terminal sterilization in heat of anything that contacts blood, pus, or tissue fluid is essential for prophylaxis against the spread of the virus of homologous serum hepatitis. This is a recognized occupational hazard among those who process instruments in hospitals. It is an ever-present threat to every patient.

*Q. We have objections from scrub nurses to sterilizing instruments unlocked because they must stop to lock them before passing them to the surgeon.*

A. Nurses' convenience remains secondary to patient safety. Instruments are sterile only when all surfaces are exposed to microbicidal steam, and steam cannot penetrate the tightly apposed box locks and ratchets.

Inasmuch as the surgeon has to open the instrument before use, why not explore the possibilities of passing ringed instruments in a closed but unlocked position? The saving in energy and minimizing of fatigue for the surgeon are noteworthy.

*Q. Can supplies be sterilized in a home oven, which is the only dry-heat sterilizer available?*

A. A home electric oven would be satisfactory as a dry-heat sterilizer at 250° F. only *if* the thermometer were sufficiently sensitive to provide a constant temperature. Because such ovens are usually heated by resistance coils, the heat distribution is likely to be uneven, and one portion of the load would be overheated while the other portion would never be heated to a sterilizing temperature. Furthermore, the chances of an unwatched home oven cooling to a temperature inadequate for sterilization are too great to warrant its use for the hospital.

*Q. Ever since we started using our steam sterilizer for dry-heat sterilization of syringes overnight, there is noticeable wear and tear on the gasket. Are we doing something wrong?*

A. Gaskets deteriorate in direct proportion to their exposure to heat. Hence the prolonged overnight exposures to dry heat add to the accumulating deterioration more rapidly than the relatively short exposures to saturated steam. Gaskets are inexpensive and easily replaced.

*Q. What is the recommended time for sterilization of hand pieces and drill points in an oil sterilizer maintained at 250° F.?*

A. Oil sterilizers are more often maintained at 320° F., and the exposure time for destruction of dry spores at this temperature with this method is one hour. In an oil sterilizer at 250° F., dry spores are destroyed after six hours of exposure.

Equipment such as you describe can be sterilized by exposure to dry heat at 320° F. for one hour

or 250° F. for six hours. In the first instance, the conventional dry-heat oven is used; in the latter, an ordinary jacketed steam sterilizer can be used. The instruments, unwrapped or packaged in aluminum foil to avert the interference or delay in heating which would result with a textile wrapper, are placed in the chamber. The sterilizer door is closed and steam is admitted to the jacket ONLY. The hot jacket ultimately heats the chamber and its contents by radiation. Overnight exposure is a convenient method for utilizing this technic to avoid inconvenience during busy daytime hours.

Stainless steel drill points can also be sterilized in saturated steam at 250° F. for 30 minutes if they are protected from contact with other instruments in the sterilizer.

Cutting edges can be sterilized in the steam sterilizer with minimal corrosion by submerging them in diethylene glycol containing 10 to 20 percent water. The instruments are arranged in shallow trays and exposed to saturated steam at 250° F. for 30 minutes.

Use of the new Vapor-Phase corrosion inhibitors also makes steam sterilization without corrosion practical.

*Q. We sterilize racks of small-gauge hypodermic needles in containers for injections in the recovery room. The racks are in covered cans, and we believe this technic is safe because quantities are*

"Lord knows I'm not one to discourage personal enterprise, Halquist, but . . ."

*small so that one container may be depleted in a few hours; supplies are not carried over from one day to the next; and personnel have been taught to keep the lid off for the shortest possible time when making a selection and to either keep quiet or to wear a mask while choosing a needle—hence, we do not think we have the problem of people "spitting" into the container.*

*Since it is impossible to sterilize the container on its side without spilling the needles, the question of whether or not we are getting the container sterile has been brought up. How is this done?*

A. The two problems are to sterilize the lumen of the needles and to sterilize the inside of the container. The first is accomplished by flushing the needle with distilled water immediately before sterilization. The residual moisture is subsequently heated to steam, which exposes the inner surfaces to microbicidal action sufficient to destroy all resistant organisms in the usual sterilizing cycle of 30 minutes.

If this step is overlooked, the lumen are never purged of air and are exposed only to the dry heat radiated from the outer surfaces, which are heated by direct contact with steam in the sterilizer. Under these circumstances, an exposure of four hours at 250° F. would be necessary to effectively destroy all organisms present in the lumen.

If you will recall the quantitative aspects of steam sterilization (see *Aseptic Treatment of Wounds*, page 59), you remember that 1 cc. of water turns into 865 cc. of steam. Hence, if you are sterilizing racks of needles in containers of about one quart capacity, 2 cc. of water left in the bottom of the container will be turned to steam sufficient to purge air from the container and provide for contact of all surfaces with moist heat.

*Q. I am a new arrival in this operating room and find that tap water is used for rinsing everything from blood pumps to Ivalon sponges. I am assured that this is acceptable technic. In my last position, however, I was assured that distilled water was essential for this rinsing. What is right?*

A. The real hazard in using tap water for rinsing blood pumps, Ivalon sponges, irrigating equipment, and so forth, lies in the possibility of leaving residual water in which the bacteria that produce pyrogens may grow in sufficient numbers to cause chemical contamination of the equipment with pyrogens. Most tap water contains the proper type of organism during the spring and fall months, when water-supply reservoirs "turn over" or "invert." The use of sterile distilled water for rinsing equipment avoids both bacteriologic and chemical contamination.

*Q. In our 80-bed hospital we use distilled water in the operating room for wetting sponges and laparot-*

*omy pads. I have recently heard that other hospitals use sterile tap water or sterile saline solution. Are we wrong in using distilled water? Can we make saline solution in the hospital?*

A. Sterile tap water and distilled water are not the ideal solutions for wound irrigation or for use in the operative field. Neither is isotonic. The concentration of each differs from that of body fluids, and the diffusion that results from their use is not conducive to wound healing. Tap water or distilled water infused into an open vein in a wound can cause intravascular hemolysis of red cells and ultimately acute renal tubular degeneration.

Physiological irrigating solutions can be made in the hospital if it has a supply of chemically pure distilled water, a source of pure raw materials, and personnel who will conscientiously render glassware chemically clean. Solutions are always made by weight, and an allowance for loss during sterilization is made. Physiological solutions are not made by dissolving a salt tablet in water.

*Q. Is it acceptable to clean spinal kits with distilled water only?*

A. Proteins, pyrogens and the contaminants are removed only when a good detergent is used. A nonionizing detergent wash followed by a thorough rinse with distilled water will minimize the likelihood of reactions.

*Q. We autoclave mineral oil at 250° F. for 60 minutes and leave it in the autoclave for three hours afterward with steam in the jacket only. Is this sufficient time?*

A. Mineral oil is more simply prepared by the following technic: Bottle 50-cc. quantities in pyrogen-free Pyrex containers. Add 1 cc. of sterile distilled water and shake well immediately before sterilization at 250° F. for 30 minutes.

*Q. When gloves are sterilized in ethylene oxide, is it necessary to position them any particular way?*

A. There are no problems of air clearance in the ethylene-oxide sterilizer; hence positioning is not critical. Care should be taken, however, to avoid compression of articles being sterilized, which would interfere with diffusion of the bactericidal gas.

*Q. Do you consider it good technic for operating-room personnel to work in the central service department making up their packs and supplies?*

A. I think it is good for operating-room personnel to work in the central service department if there is no better use for their services. They aid in maintaining the standards and acquire some comprehension of the amount of work that is involved in keeping the supply lines operating smoothly. Economically, however, this is a gross waste, and operating-room

personnel should not be depended upon as a permanent contribution to central supply room labor.

*Q. We soak our instruments in 70 percent isopropyl alcohol in stainless steel containers. These are washed and dried periodically, and the solution is changed. Often there is a white, crusted, flaky deposit around the edge of the container and on the instruments. What might cause this?*

A. If the alcohol solution is made with tap water, alkali earth salts in the water are left behind as scum when the alcohol evaporates. Residual soap on the instruments immersed in alcohol will also appear as a precipitate when alcohol evaporates. If the containers are not thoroughly rinsed after washing, a film will result.

There is no place for chemical disinfection in modern surgical practice except for use with new, non-heat-stable equipment or for the storage of transfer forceps. Terminal heat sterilization of instruments contaminated with blood or tissue fluid is imperative if transmission of the virus of homologous serum jaundice to patient and personnel is to be averted. This contaminant remains an undetected potential of every patient's blood.

*Q. What equipment is needed in the sterilizing room which is located between two operating rooms?*

A. The sterilizing room between operating rooms is usually equipped with a dry-heat sterilizer; a blanket warmer for dehydrating cotton blankets; a warmer for flasked solutions; an emergency sterilizer; an instrument washer-sterilizer for preoperative and terminal sterilization of instruments, and a flushing-rim service sink for rinsing the mop used to clean the floor between cases.

Scrub sinks are located at the far end of the room. The surgeon is thus forced to pass through the sterilizing room daily. He is exposed to its problems, and his responsibility in this area, whch is usually dormant, is aroused by daily exposure. Modern technics of ventilation and acoustic treatment, along with improved sterilizer design, have eliminated the burden of heat and noise.

The ceiling in this area should be of pressed cork to provide acoustic properties and to prevent condensation of steam which would drip on exposed sterile instruments.

*Q. Are cabinets necessary in the operating room or is it better to arrange a room without them?*

A. Some form of cabinet arrangement is necessary in the operating room to accommodate the sterile supplies necessary for a day's work. Another cabinet of shelves provides space for unsterile equipment and supplies. Cabinets are usually located on walls adjacent to the corridor door so that supplies can be replenished or removed without inconvenience to the team at work in the room.

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By Dorothy W. Errera, R.N.

### Sterilization

Fallon, R. J.: "Steam Penetration into Containers for Surgical Dressings." *Lancet* 2:41, July 1, 1961.

In England, dressing drums and metal and cardboard boxes are used more often than ordinary wrappers for packaging supplies for sterilization. The perpetuation of these technics has inspired interest in and enthusiasm for high-vacuum sterilizers which overcome such frustrations to steam sterilization as improper packaging and loading.

But, as the author of this article points out, gravity air-clearance steam sterilizers are and will continue to be in use for some time as efficient, safe instruments of steam sterilization. He cautions that there should be lively concern for penetration of steam and air clearance in these containers as well as with more conventional wrappers.

The first part of this study is not particularly applicable to situations in the United States, where packaging for sterilization is almost consistently oriented to providing individually wrapped supplies. Discussion here more often centers about types of wrappers, and most recently, nylon sheeting has held center stage.

Nylon was included in this study. First, its permeability to steam was demonstrated. Cotton towels were packaged in nylon bags (0.0254 and 0.0508 mm. film). As much air as possible was expressed, and the bags were sealed with a heat-sealing machine. They were weighed before and after sterilization at 126° C. (258° F.)

In all instances, there was a weight gain averaging three to five percent after sterilization, indicating the presence of steam. To rule out the possibility of steam entering through defects in seals, the bags were immersed in water after sterilization. As some air was always present in the bags, leaks would have been detected, but none were found.

Then, similar packs (eight 20x30 towels folded to make 12 thicknesses) were made up and sealed. Thermocouples were passed through a hole in the bottom of each pack, and the hole was sealed with heat-seal tape.

In five out of six experiments the nylon packages required 16-18 minutes more to heat than a 10"x9" dressing drum with a like load. Slow heating was attributed to the mixtures of air and steam inside the sealed package.

Nylon appears to interfere with heating times not because it offers resistance to the entry

of steam but because it impedes the escape of air. Nylon film is described as becoming brittle on repeated use and difficult to seal, particularly after one exposure to steam. As in other wrappers, holes often escape detection. In the high-vacuum sterilizer, sealed nylon bags burst when any appreciable quantity of air was present.

This study demonstrates again that penetration times in the steam sterilizer vary with containers, wrappers, and packaging technics. It is emphasized again that the loosely packaged load offers less resistance to penetration; hence heating is not delayed. Closely woven, impervious materials distinctly impede the flow of steam. For example, the metal box with closely woven built-in filters required 20–30 minutes heating, but when the filters were omitted, the box required only two to three minutes.

EDITOR'S NOTE: Air in a steam sterilizer interferes with sterilization for several reasons: (1) because air-steam mixtures do not develop temperatures characteristic of saturated steam under the same pressure, bactericidal action is decreased; (2) air and steam do not mix, and great variations in temperature will result in various parts of the sterilizer chamber; (3) air reduces the penetration power of steam by preventing its convection into packages and liberation of latent energy; (4) air prevents mechanical contact between steam and bacteria. Being heavier than steam, it will gravitate and pool wherever there is any interference with its escape.

DeSautels, Robert E.: "Aseptic Management of Catheter Drainage." *N.E.J.M.* 263:189, July 28, 1960.

Certain it is that constant bladder drainage and infection have been an inseparable duo. But now it is known that aseptic technic is instrumental in eliminating these urinary-tract infections.

Three points in the system are considered portals of entry for bacteria: the urethral meatus; the connecting tube; and the distal end of the drainage tube.

Asepsis is rigid. The drainage equipment—bottle, stopper, adapter, and tubing—are sterilized in saturated steam at 250° F. for 30 minutes. The meatus and surrounding tissue are washed with hexachlorophene and 1:1000 aqueous benzalkonium chloride. The catheter is lubricated with sterile jelly. The distal urethra is irrigated with the same disinfecting solution. Once daily thereafter in males, and two or three times daily in females, the area about the meatus and catheter is cleaned with 1:1000 aqueous benzalkonium chloride. A gauze pad saturated with the germicide is

usually taped to the penis and changed daily.

When the apparatus is disconnected for any purpose the connection between catheter and drainage tube is treated as a sterile field. The junction is disinfected with 70 percent ethyl alcohol before the equipment is disassembled. The parts are wiped with sterile sponges saturated with alcohol. The irrigation is done with aseptic technic. If the catheter is inadvertently contaminated or if there is any question of contamination of any part of the set, a fresh, sterile ensemble is installed.

To prevent contamination from bacteria travelling upstream, the distal end of the drainage tube is never allowed to contact the urine; it is never handled with bare hands and is not allowed to rest on the floor. Collection flasks are emptied and replaced at frequent intervals so that urine never reaches the level of the end of the tube.

Does it work? It would appear so.

Of the 51 patients treated with care, 41 had sterile urine cultures when the catheters were removed. In the 10 patients who had positive cultures, a break in technic could be documented in seven instances: three were dressed with poor technic; two were contaminated when catheter and adapter were handled carelessly, and two became contaminated when drainage bottles overflowed.

Urine cultures in this category of patient have been almost consistently positive despite prophylactic antibiotic therapy. So, it would appear that the urinary tract can be maintained in a sterile condition by treating the meatus and drainage system with the respect of aseptic technics.

Lincoln, Ralph E., and Roth, Norman G.: "A Decontaminator-Washer-Dryer-Powderer for Surgical Gloves." *Appl. Microb.* 9:81, January, 1961.

At the Fort Detrick laboratories of the U.S. Army Chemical Corps, approximately 1,200 rubber gloves, free of pathogens but not sterile, are used per week. Man hours are valuable, and the number involved in caring for rubber gloves plus the recognized need for terminal disinfection prompted a study that has resulted in an automated technic to terminally disinfect, wash, dry and powder (outside and inside) grossly soiled gloves.

A 1957 RCA Whirlpool combination washer-dryer is modified to provide cycles for the glove problem. Temperature range is limited, and audible indicators and automatic air heater controls are added.

The machine fills to normal level with 3.5 gallons of water

at 120°-125° F. Sodium hypochlorite (the chosen germicide because of its sporicidal action and relative compatibility with rubber) is added to provide 500 ppm free chlorine.

After the gloves are washed for 10 minutes, the washer is pumped out and they are tumbled for one minute. A low-sudsing, non-ionic detergent is added to make 0.2 percent solution by weight, and the gloves are washed at the same temperature for five minutes. A two-minute pump-out and tumble operation follows, and then come two rinses, pump-out and tumble combinations, each taking about three minutes. There is no spin cycle.

Talcum or starch powder is added directly to the wet gloves—approximately one gram per pair. In the author's experience, no more talc is necessary for gloving a dry hand.

The gloves are then dried by tumbling at 125°-130° F. for 30 minutes or less, depending on the size of the load and the age of the gloves.

Fifty pairs of gloves weigh approximately 3.5 pounds. The machine is most efficient with a load of 40 to 60 pairs.

To measure the bactericidal efficiency of the process, gloves were contaminated with aqueous suspensions of the spores of *B. subtilis* var. *niger* and suspensions of red blood cells and spores. Experiments showed that decontamination was achieved by any of the following: 500 ppm sodium hypochlorite at 75° F. for 10 minutes; 500 ppm at 120° F. for five minutes; or 100 ppm at 120° F. for 10 minutes. The gloves were not sterile after the decontaminating wash, but no viable spores from the deliberate contamination were found.

The rate of deterioration using this process was measured and compared with that of manual washing and terminal sterilization in steam at 250° F. for 15 minutes. Tensile strength was not noticeably decreased until after 15 wash cycles, whereas deterioration appeared to be progressive with exposure to steam.

Time and motion studies were only approximate, but it appears that in processing 60 pairs of gloves, 20 seconds are necessary for every pair washed with the automated technic, whereas 105 seconds are necessary with the manual technic.

Purchase of gloves for the laboratory was cut 80 percent in the first 15 months of trial.

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